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Mac Portable
Zenith MinisPort
HP 11P LaserJet
386Max
5 Data Swappers
2 Mac Drives
THE NEW DELL SYSTEM*325 25 MHz 386.

An even better value at these low prices.

**Commercial Lease Plan. Lease for as low as $127/month.**
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DELL SYSTEM*320 12.5 MHz 286.
The price says it's an entry-level system. The performance says it's a lot more.

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STANDARD FEATURES:
- Intel 80386SX microprocessor running at 25 MHz.
- Choice of 1 MB, 2 MB or 4 MB of RAM expanded to 16 MB (using a dedicated high speed 32-bit memory bus).
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- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
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This new full-featured, battery powered 386SX laptop computer costs less than most 286 laptops.

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- Page mode interleaved memory architecture.
- 1 MB 40-pin socket for 25 MHz or 386SX memory expansion.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 10 key keyboard.
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- 1 full-speed 8-bit AT expansion slots available.

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DELL SYSTEM*210 12.5 MHz 286.

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STANDARD FEATURES:
- Intel 80286 microprocessor running at 12.5 MHz.
- Choice of 512 KB 640 KB or 1 MB of RAM expandable to 16 MB (using the system board).
- Page mode interleaved memory architecture.
- 1 MB 40-pin socket for 10 MHz or 25 MHz memory expansion.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 10 key keyboard.
- 1 parallel and 2 serial ports.
- 1 full-speed 8-bit AT expansion slots available.

**Commercial Lease Plan. Lease for as low as $127/month.**
- Term Extended Service Plan pricing starts at $370.

DELL SYSTEM*200 10 MHz 286.

The price says it's an entry-level system. The performance says it's a lot more.

**Commercial Lease Plan. Lease for as low as $127/month.**
- Term Extended Service Plan pricing starts at $370.

STANDARD FEATURES:
- Intel 80286 microprocessor running at 10 MHz.
- Choice of 512 KB, 640 KB or 1 MB of RAM expandable to 16 MB (using the system board)
- Page mode interleaved memory architecture.
- 1 MB 40-pin socket for 10 MHz or 25 MHz memory expansion.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 10 key keyboard.
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Equipped with VGA, optional Intel or WEITEK coprocessor, and hard drives ranging from 40 MB to 322 MB, it still leaves 6 expansion slots free.

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Why don't you check out the specs and prices on the next page. Or look through some of our other new systems.

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- Sell them at an even lower price
- Drop the price
- Give them away free

We’ve lowered, reduced and dropped the price of the Dell System®325. See inside for details.

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Circle 78 on Reader Service Card
At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing a better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

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PC MAGAZINE, January 1989, "In a field of powerhouse machines there can only be one winner, and ALR's FlexCache is it."


PC WEEK, July 1989, "Based on a series of benchmarks run last week on Advanced Logic Research, Inc.'s prototype 486 desktop system, ALR will enter the 486 market with a bang."
California Anza-Borrego Desert State Park
(Cannonball-shaped sandstone. These concretions are formed of onion-skin layers of minerals resistant to erosion.)

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from the leader in 386™ technology.

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What you see is what you get. Also known as WYSIWYG, this on-screen editing feature lets you see exactly what your changes are the instant you make them.

Location, location, location.
Use the ruler to make everything flush left, or right. Or centered. Single-spaced. Double-spaced. Anywhere and any way you want it. With one simple click.

It's a wrap.
You can move or resize any positioned object, such as a chart or table, and watch the text automatically wrap the whole thing into a nice, neat package.

We've got tables covered.
This feature makes creating a table as easy as creating a spreadsheet, sending the TAB key the way of carbon paper.

Make sure your numbers add up.
Through dynamic data exchange (DDE), any changes made to the original spreadsheet will show up here automatically. It's convenience words can't describe.

Something happens the first time you look at new Microsoft® Word for Windows®

You stare. A conscious close of the mouth may even be necessary.

Don't worry. It's a standard reaction. Because when it comes to word processing on a PC, Word for Windows isn't like anything you have ever seen before.

In creating it, we took the collective experience of producing the two leading word processing programs, powerful Word for the PC and the Macintosh. Consequently, every level of word processing, from the quick memo to the complex document, becomes very easy and simple to do. Downright elementary, actually.

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evolve more on these
s in the last ten years.

See, point, do.
A liberal collection of icons located on the Ribbon replaces an endless string of commands to let you format characters by eye instead of by memory.

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Change everything from the size of your type to the look on your face.

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Word for Windows was designed with the mouse in mind, but it can be used equally well with keyboard commands.

Customize your menu
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You can create your own time-saving menu commands to speed up your daily routine. And we've combined sophisticated features like macros, Styles and glossaries into Document Templates, bringing task automation to a new level.

strokes. Now you can rely on icons that are instantly understandable. No more prompt this for that to happen. Prompt that for this to happen.

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HOW DO YOU CRUSH AN 80486?

You drop it from a plane. Here's an update on the ups and downs of mail order.

I admit it: I'm a mail-order junkie. My two main home-office computers are mail-order clones. Almost all the rest of my personal-use equipment—printers, monitors, cables, modems, add-in cards, supplies, software—also came by mail. Name something computer-related, and I've probably bought it by mail.

The reason why I'm such a devoted mail-order fan is simple: The clone computers I've ordered by mail typically cost about half to two-thirds of what similar store-bought systems would have cost. Brand name hardware and software also generally costs less by mail. But there's no free lunch; there have been snags, ranging from bad motherboards to bogus power supplies to flaky chips.

Then there are the times when things really go wrong. Look at the mail-order nightmare shown in the photos below; that's what's left of a brand-new 80486 machine that was shipped to BYTE for evaluation. Along the way, it had the extraordinarily bad luck to end up on the bottom of a pile of cargo that (literally) fell out of a plane at a New Jersey airport. But since that system was covered by the shipper's insurance, we received a replacement within days (see our First Impression of the Hawk II on page 96D).

Similarly, the other problems that I mentioned were covered by warranties, and the end results were reliable, fully functional, low-cost systems. The only real drawbacks were the moderate bother of troubleshooting and the hassle of sending the machines back for repairs or replacement. In effect, I was subsidizing mail-order's low cost with my own labor and inconvenience.

If that were the end of it, mail order might be worth considering only in situations where you are free to supply labor or suffer inconvenience. However, mail order is changing.

For one thing, mail-order shops are better at testing the equipment they ship, and, when problems do crop up, the larger, reputable firms offer really good telephone support with toll-free numbers, reasonable hours, and knowledgeable technical-support staffs.

Some mail-order firms have beefed up their warranties to include on-site repair service. Other companies guarantee fast repair times or offer loaner computers. With policies like these, the best of the mail-order companies can come close to matching the kind of service you might normally associate with a retail or value-added reseller (VAR) operation.

Mail order isn't good for some things. For example, if you want the latest technology, brand name manufacturers are your only choice, and some of these are not available by mail. Or if out-of-the-box reliability is critical, you'll do better by having a local dealer or reseller set up and test your system before it's delivered.

In the event of a problem, a service-minded local firm probably can respond much faster than most mail-order companies. And, if your computing needs are complex (e.g., if you're trying to interconnect a large quantity of dissimilar equipment), a hands-on, personally involved local dealer or reseller is much more able to help you make the right choices, and to get everything up and running, than is a mail-order firm.

That's why BYTE buys its office equipment from a number of sources, including VARs, retail, and mail order. If you choose carefully, you can find the right combination of price and service you need. With commonsense guidelines (like those printed in the Microcomputer Marketing Council's "Buy with confidence" ad that often appears in BYTE), mail order can be a great addition to your purchase options. Check it out.

—Fred Langa
Editor in Chief
(BIX name "flanga")
Integrated Software for Schematics & PCB Artwork

Introducing HiWIRE® Plus

Wintek’s smARTWORK® pioneered low-cost printed-circuit-board CAD. Then HiWIRE set the standard for productivity and ease-of-use in schematic capture. Now Wintek introduces HiWIRE-Plus, integrating HiWIRE’s schematic features with a powerful printed-circuit-design facility.

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HiWIRE-Plus gives you all the design freedom you want: you choose the grid size, trace widths, and pad shapes. The board size and number of layers are virtually unlimited. HiWIRE-Plus is perfect for surface-mount, microstrip, and ECL applications.

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- One tool for schematics and printed-circuit artwork
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- PCB library with DIPs, SIPs, SMDs, PGAs, TOs, and edge and D connectors
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- 800 number for free support

Current Versions

HiWIRE-Plus V 1.3r0
smARTWORK V 1.4r6

System Requirements

- IBM PC, XT, AT, or PS/2 with 512K RAM, printer port, color monitor, and CGA, EGA, or VGA graphics card
- Microsoft Mouse
- IBM ProPrinter or Epson dot-matrix printer, and/or
- Houston Instrument or Hewlett-Packard pen plotter

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Circle 400 on Reader Service Card
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On a LAN.

The big difference is the

OfficeVision is IBM's first SAA application.

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But to OfficeVision users, these kinds of differences won't make much difference. In fact, they'll hardly be noticed.

That's because, at workstations running OS/2 EE, OfficeVision looks the same across all of its environments. So anyone comfortable on one operating system can feel at home on another.

Better still, the way it looks and works offers you powerful advantages.

Even if you're delighted with your present office software, you should know what OfficeVision (and SAA™) can do for your future.

Software that makes other software work better.

For starters, OfficeVision will give you an arsenal of basic office tools: E-mail, word processor, calendar, address book, phone dialer, etc. Users can arrange them on a screen as if the screen were an ordinary desktop. (Except that ordinary desks don't have icons, mice or windows.)

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For example, in the middle of an OfficeVision screen, you'll be able to "snap in" PC applications
M OfficeVision.

re's almost no difference.

like Lotus 1-2-3® or Microsoft Excel® while, at the same time, you can run larger business applications on host computers.

What’s more, programs written for Presentation Manager® can be loaded into their own OfficeVision windows. Which means not only can you see several such programs at once, you can often swap information between them. (See box.)

And thanks to OfficeVision’s SAA interface, technicalities that often mystify users (like communications, multitasking and cooperative processing) become simple.

Also, OfficeVision has been designed to work with your previous investments. It will accommodate DOS workstations and nonprogrammable terminals, and you can install it on an as-needed basis.

OfficeVision is available now.

OfficeVision/2 Release 1.0, for LANs, is now available and can be connected to currently installed AS/400™, MVS, and VM systems.

OfficeVision/MVS Release 1.0 is also available now.

OfficeVision Release 2.0 will be ready next Spring. With versions for OS/2 EE, OS/400, VM and MVS, it will be OfficeVision at full power, bringing with it the system-wide benefits of SAA.

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To learn more, call your IBM Marketing Representative right away.
Turbo Pascal, the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple’s Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

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The award-winning Turbo Debugger now includes an object inspector and hierarchy browser. And Turbo Debugger can debug any size program.

Upgrade objectively
Pascal owners:
Upgrading from Turbo Pascal 5.0 to 5.5 is only $34.95 plus $5 shipping and handling ($75 plus shipping and handling for owners of Turbo Pascal 4.0 or earlier). And upgrading from Turbo Pascal 5.0 and earlier to Turbo Pascal 5.5 Professional is only $99.95 plus $10 shipping and handling. To order, CALL (800) 331-0877.

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- Inheritance
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- Constructors & Destructors
- Object constants
- Compiles @ > 34,000 lines/minute
- New integrated environment tutorial
- Hypertext Help with copy and paste
- Enhanced smart linker & overlay manager
- Support for 8087/80287/80387
- Integrated source-level debugging

Code: MA46
At last!
A new HP LaserJet
just for you.

At only $1495; it's got your name on it.

The HP LaserJet printer family has expanded—in a small way.

The new HP LaserJet IIP (as in Personal) fits right on your desk. And, with a price almost half of the multi-user LaserJet Series II, into most budgets.

Its simple front panel gives you easy, push-button control over the menu, the 14 internal fonts, form feed and other functions. It handles four different paper sizes: letter, legal, executive and A4, as well as envelopes. In portrait

*Suggested U.S. list prices:
LaserJet IIP $1495;
LaserJet Series II $2695.
Dealer prices vary.
or landscape configurations. At four pages a minute. From one or two paper bins (the second is optional).

The 512K standard memory is upgradable to 4.5 Mbytes for more complex graphics and publishing programs.

The new HP LaserJet IIP printer.

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Circle 114 on Reader Service Card
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New Connector Could Speed Memory Access

A new technology on the way should help shrink the gap between memory-access speeds and the rapidly increasing clock speeds of microprocessors, a gap that’s hampering major advances in system performance. One thing that slows down computer performance is the connection between a system board and an add-in board. Augat, Inc. (Attleboro, MA) has designed a new connector that reduces signal propagation delay and interference (or “crosstalk,” as it’s called in the circuit business). One key feature of the new connector is that it reduces signal propagation delay to one-third of the delay time inherent in conventional fiberglass “four-row box” connectors, which are typically used to hook expansion boards to the backplane bus or system board.

Augat says that its new Electronically Invisible Interconnect (EII), which is made from a flexible polyimide material, not only can handle three times the propagation speeds of conventional connectors, but also exhibits much lower signal distortion and interference (or “crosstalk,” as it’s called in the circuit business). One key feature of the new connector is the absence of ground pins, which are replaced by a single continuous ground plane, allowing as many as 80 signal lines per linear inch versus 20 to 40 lines per inch on conventional connectors. The impedance of the flexible connector is also matched to both the daughterboard and the system board, which is another factor in producing high signal integrity. (The connector comes standard with an impedance of 50 ohms, but it can be customized.)

The EII costs three to four times the price per line of a standard connector but requires fewer lines because the ground pins are eliminated. According to product manager Mike Prisco, initial customers will be mainly mainframe and superminicomputer vendors. However, workstation makers will eventually begin using these types of connectors. Augat engineer Muti Siddiqi commented that a major application for this type of connector will be in cache memory designs, speeding up propagation between the memory cache, the processor, and main system memory.

“The connector industry is going through a crossroads,” said Prisco. “Signal integrity is a major issue. People are talking about it and doing something about it.” Prisco said other companies will be offering advanced connector products in the near future. Augat has prototypes of the EII available now and plans to be in full production this year.

Mighty Processors Will Help “Humanize the Interface” with Speech and Vision

With Intel promising a 250-MHz chip cranking out 2000 MIPS and Motorola no doubt quietly planning the same, many personal computer users in the next 10 years will have more processing power than they know what to do with. But developers will be able to tap into that power to go beyond the 1980s-style keyboard and mouse to create computer interfaces that are truly revolutionary. “I believe that within two to three years we’ll see single-chip 250-MIPS processors available as improvements in CMOS and package technologies continue,” says Andrew Heller of Kleiner Perkins Caufield and Byers, a computer consulting firm. “At that kind of power you start to think about humanizing the interface, not just being user-friendly,” he says. “We’ll see things along the line of improved speech and handwriting recognition, and visualization.”

David House, vice president of Intel’s Microcomputer Components Group, agrees. Extremely integrated devices, expected later this decade, will provide enough raw processing power to bring full-motion video and speech recognition to tiny, single-chip computers, House says.

continued
One of the highlights of the recent IEEE Wescon show was automated design software, aimed at speeding up the process of developing, testing, and manufacturing electronic components. No longer limited to programs for printed circuit board design, these packages now have more sophisticated capabilities, such as auto-routing, logic synthesis, and simulation. A big exhibit section, called the Automated Design Center, featured some 75 vendors showing products that can help eliminate some of the dirty work. Many of these packages were running on personal computers rather than workstations. Exhibitors included CAD Software, OrCAD Systems, Racal-Redac, and Applied MicroSystems.

In spite of an economic slowdown this year, the outlook for the electronics industry looks promising, economist Mario Belotti told an audience at Wescon. Belotti, a professor at the University of Santa Clara, said businesses will spend less this year on equipment, but what they will spend will be for modernization, which means more money for electronics and telecommunications. Global competition will fire up in the 1990s, he said, with the emergence of high-tech facilities in Indonesia and other Far East countries.

Will U.S. Memories become only a memory? In recent months, Sun Microsystems, Apple Computer, Unisys, and NCR declined to join the cooperative chip-production venture aimed at ensuring a domestic supply of memory chips. Sun said that its decision was based on its assessment of "long-term DRAM trends, the company's memory requirements, and the risks and benefits of such an investment." Sun has "long-term contracts in place today" with American, European, and Japanese memory chip suppliers, a Sun spokesperson said. So far, seven companies have committed to help fund the chip cooperative: IBM, Hewlett-Packard, Digital Equipment, Intel, LSI Logic, National Semiconductor, and Advanced Micro Devices.

Michael Homer, Apple Computer's director of product marketing, says that whether central processors operate at 25, 100, or 1000 MIPS, the challenge comes in designing new interfaces, including continuous speech-recognition and speech-synthesis capabilities. "The biggest issue won't be how fast a computer can go, but how we can use that power to improve communication with the system," Homer says.

"To me, the most interesting thing will be communicating with the user: the user interface," says Andrew Hertzfeld, self-styled "software wizard" and member of the original Macintosh engineering team. "Another interesting way to use all those MIPS is to interpret what the user is going to do next," Hertzfeld says, "to try to present the user with solutions instead of running through some menu hierarchy."

### Single Chips Feature Double Graphics Modes

Two chip designers have taken two IBM graphics modes and squeezed them onto one slab of silicon, integration that should yield less-expensive graphics boards.

The new IGA (Integrated Graphics Array) controller from Integrated Information Technology (Santa Clara, CA) combines a VGA controller and an 8514/A controller on a single piece of silicon. The VGA section can handle CGA, MDA, Hercules, EGA, and standard VGA modes—up to 640 by 480 pixels with 16 colors, or 320 by 200 pixels with 256 colors from a palette of 256,000—as well as "Super VGA," which can handle 800 by 600 pixels with 16 colors. The 8514/A controller can display up to 1024 by 768 pixels with 256 colors from a palette of 256,000; it matches the IBM 8514/A graphics commands for drawing lines and rectangles and moving graphics blocks around on the screen.

PC graphics cards exist that offer both VGA and 8514/A compatibility, as IIT's Gene Parrott points out, but they really just combine two complete video subsystems on a single card, each with its own memory and support chips. And while the VGA section of one of these two-in-one cards typically uses the same DRAMs that IIT's IGA chip requires, the 8514/A side usually requires specially designed video RAMs that cost two or three times what standard DRAMs cost. VRAMs simplify video controller design, but because they take care of all CPU/video conflicts internally, they're more expensive to produce, and, accordingly, that pushes up the prices of cards that use them.

But the IGA chip uses just one video subsystem—with standard DRAMs. The key to making it work, according to Dr. Y. W. Sing, IIT's vice president for engineering, was eliminating the standard hard-wired graphics controllers. To replace them, IIT designed a 25-MIPS RISC processor for handling graphics commands and then built the VGA and 8514/A functions around it. Sing admits that an IGA video controller board might not be quite as fast as some systems that are based on VRAMs.

The chip is currently being tested by several potential customers, and it should appear in half-size PC graphics cards next year, Parrott says. A low-end IGA-based card might have 8514/A command compatibility, 480- by 480-pixel resolution, and a list price as low as $399. That would change 8514/A from a luxury to a commodity, since right now 8514/A cards are more expensive than their high-performance competition, such as Texas Instruments' Graphics Architecture cards using Texas Instruments' 32010 and 32020 graphics controllers.

Trident Microsystems (Sunnyvale, CA) has also paired 8514/A and VGA on the same slab. The Trident Advanced Video Array 9000, a 1.2-micron CMOS chip, is register-compatible with the 8514/A specification as well as with VGA, EGA, CGA, MDA, and Hercules graphics. It supports resolutions of 1024 by 768, 800 by 600, and 640 by 480 pixels, and up to 256 colors. As with IIT's chip, the TAVA will work with DRAMs instead of VRAMs. Trident says that it will provide software drivers for several applications, including Windows, GEM, PageMaker, Lotus 1-2-3, Ventura Publisher, WordPerfect, and AutoCAD, as well as the X Window System, Windows/386, and Presentation Manager. The company expects to.
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Here's how to get that digitized photo of Elvira painted on the front of your house: The new Michelangelo Paint Jet System produces images as large as 5 by 5 feet on just about any type of surface, including concrete, brick, wood, tile, cloth, and glass. The printer connects to a PS/2 computer; its controller directs a paint sprayer to put down three primary colors (yellow, magenta, and cyan) line by line. The jet sprays acrylic resin paint that the vendor says dries quickly and is water resistant. Painting a 5-foot-square job takes up to 4 hours. And the price, like the images, is big. A representative of distributor Fleming-Dobler B.V. (Westervoort, Holland) said the Paint Jet System costs around $100,000.

Users have three main needs that the computer industry still hasn't fulfilled, said David Liddle, chairman of Metaphor Computer Systems, at a recent conference: the ability to access data no matter where it is, tools that can be operated by all users, and tools that let even computer novices develop applications. While concepts such as Structured Query Language and client-server computing have helped improve access to data, users still have to become experts in their applications and ping-pong over the abstractions of their jobs and the abstractions of computing, Liddle said.

Hewlett-Packard (Palo Alto, CA) has developed a new microprocessor design technology that the company says will enable it to put its entire RISC-based Precision Architecture on a single chip and to at least double the performance of systems that use the CPU. The new CMOS chip, which is about 2 inches on each side and contains about 1 million transistors, will offer clock speeds of greater than 48 MHz and require less than 10 watts of power, HP says. Integer performance will reach 50 to 60 MIPS, according to an HP official. Although the chip will first appear in minicomputers and workstations, HP plans to use it across its entire line of computers.

Low-End Macs Can Now Run Mac II Programs

Macintosh users who are operating a 68000-based machine will be able to run math-intensive programs for high-end Macs, thanks to new software from a West German company. XMath, from d'ART Computer (Kiel, West Germany), emulates Motorola 68020 and 68881 instructions on a Mac SE, Plus, or

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*Due to the volatility of the 286 market all prices are subject to change.*
Intergraph (Palo Alto, CA) has signed up Samsung Electronics as a second-source producer of Intergraph's Clipper RISC processor. Samsung will also help in the development of future versions, which could make Intergraph an even more significant producer of RISC chips. The company says that it has sold about 30,000 Clipper-based systems, as compared to Sun's 35,000 SPARC-based systems.

As for a shakeout in the RISC business, Intergraph's chief of its Advanced Processor Division said that it's not likely. Howard Sachs, who helped design the Clipper chip when it originated at Fairchild Electronics, said that there will "always be four or five players in the RISC market." He named seven: IBM, Sun, Hewlett-Packard, Motorola, MIPS, Advanced Micro Devices, and Intergraph. Increased migration to Unix and development of greater software compatibility will allow customers to choose more than one RISC architecture, he said.

XyQuest (Billericia, MA) has published a guide to the XyWrite programming language, which combines word processing functions with programming tools. The 124-page book ($29.95 plus $2 shipping) comes with a disk of sample programs and utilities. Phone (508) 671-0888.

Great expectations: Joe Tucci, president of Unisys (Blue Bell, PA) said he's counting on his company's immense contract with the Air Force to propel the firm into the forefront of desktop computing. Unisys, known for its large systems, recently won a bid to deliver $700 million worth of computers to the Air Force; that's 250,000 80386-based AT compatibles. (Zenith, which expected to land the Desktop III contract, subsequently protested the award, and the situation was unresolved as we went to press.) In an interview with Microbytes, Tucci also said that "the potential is there" to sell even more computers to the Air Force.

MIT Gets X Window Running on NeXT Cube

While most of the Unix world has moved toward the X Window System as the windowing system for workstations and applications, the NeXT Computer uses a proprietary windowing system. But now MIT (Cambridge, MA), which developed and distributes X Window, has come up with a version that runs on the NeXT cube. After buying a number of NeXT machines, MIT wanted to integrate them into its Athena computing environment, which makes use of X Window.

The X Window port to the NeXT lets the user create a NextStep window on the screen, which is equivalent to an X Window device, according to NeXT, Inc.'s Barry Silverman, who worked with MIT on the X Window port. This means that any application that adheres to XII calls can run within this window on the NeXT.

Initially, the port supports XII release 3, and eventually it will support release 4. MIT will make the X Window port for the NeXT publicly available on tape later this year. MIT will monitor bug reports and make changes to the code as necessary.

NeXT has no plans to support MIT's port of X Window to its machine, according to Silverman. The project was primarily for MIT's internal use, but, as is customary, MIT releases its programs for public use.

TI's Chip Could Cut Cost of Graphics Boards

So-called beyond-VGA graphics boards, which offer VGA compatibility and resolutions of up to 1024 by 768 pixels, are hard to come by for less than $1000. But this situation could change as manufacturers start using Texas Instruments' new Business Graphics Array logic controller for TI's 34010 graphics coprocessor. The new 34092 logic chip replaces much of the custom glue logic currently required on 34010-based high-resolution graphics boards.
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Circle 46 on Reader Service Card (DEALERS: 47)
Jim Manzi can't be accused of overhyping Notes. He warned that this vision of collaboration does not yet put up on a screen and expect immediate miracles,” Manzi said.

Although Lotus officials say that Notes provides for “many-to-many interaction” among geographically immediate miracles,” Manzi said. Although Lotus officials say that Notes provides for “many-to-many interaction” among geographically

Manzi said it can “reach across space and time” — the Notes vision of collaboration does not yet include people who use computers not based on Intel processors. Lotus is considering plans to bring groupware to non-DOS or non-OS/2 systems, “but we’re making no announcements,” said Larry Moore, general manager of the Lotus division that brought Notes to market. It’s “technically feasible” to adapt the software to Macs or Unix systems, said Ray Ozzie, president of Iris Associates (Westwood, MA), which conceived the product back in 1984.

Facing a crowded Fall Comdex conference room, Gordon Eubanks, president of Symantec, said, “The last time I spoke before an audience this big was at a show called CP/M ’83. Things in the industry were changing then, too.” Eubanks, who in 1983 was marketing Digital Research’s version of CP/M, said that things would have been much better if “all those people had just bought CP/M-86.”

Along with Valentine’s Day this is the month to celebrate National Engineers Week (February 18–24). This year the sponsors are conducting programs aimed at encouraging high school students to consider “the exciting world of engineering.” Illustrious engineers such as Burt Rutan will be spending the week teaching students.

And the National Academy of Engineering will present the first annual Charles Stark Draper Prize to two men to whom this entire industry is eternally indebted: Jack Kilby and Robert Noyce, who independently invented the IC.

The chip provides a memory controller and a “display pipeline controller,” which handles the resolution and color palette on the screen. Otherwise, board manufacturers will have to implement these memory and display control functions themselves.

The new chip will cut in half the required size of 34001 graphics boards and will significantly reduce the development and production costs of such boards, according to Leslie Price of the TI Graphics Group (Dallas).

“The least expensive TIGA [TI Graphics Architecture] boards are in the $800 to $900 range,” she said. “Because of this chip, prices should drop to about $500 or $600” by late this year, she added.

TI’s 34010 chip coprocessor is used in high-resolution graphics boards for both Intel- and Motorola-based systems. Hewlett-Packard, Number Nine, Truevision, and several others offer graphics boards based on the 34010. With the new logic chip, these companies should be able to offer more competitively priced high-resolution graphics boards.

Prototypes and specifications of the 34092 are slated to be available soon, the company said, with volume production scheduled for the middle of this year. TI is working on a similar chip for its more powerful 34020 graphics processor.

**After the Revolution: A Sampling of Forecasts**

The end of a decade has a way of stimulating prognostication. As this issue went to press, 1989 was gasping its last breath, and some of the people who helped shape computing in the 1980s were talking about what they expect computing to be like in the 1990s. Here are some forecasts.

**Steve Jobs,** chairman of NeXT: “The era of personal computing has ended.” The 1990s will be the decade of “interpersonal computing,” putting users in an environment that transcends connectivity, E-mail, and shared data.

**Jim Manzi,** chairman of Lotus: “The PC revolution is now over.” Service—serving all those computers and helping users deal with complex programs—and not raw technology, will drive the next cycle in the personal computer industry. Revenues from systems integration services will jump from $5 billion this year to about $15 billion in 1993.

**David House,** vice president of Intel’s Microcomputer Components Group: By 1993, look for the 80586 chip, containing 5 million transistors; by 1999, Intel will deliver the 80786, a chip that will run at 250 MHz and zip through 2000 MIPS. With this much power behind them, user interfaces will change dramatically.

**Steve Ballmer,** vice president for systems software at Microsoft: Along with graphical user interfaces, two elements will be critical in the next half-decade: the ability to work easily with multiple applications from different software developers, and “information at your fingertips,” the ability to use all data you need with any application.

**Gordon Eubanks,** president of Symantec: “In the 1980s, the PC changed the world, if not the computer world, forever.” In the 1990s, the role of personal computers will expand from serving individual needs to serving the collective needs of groups.

**Bill Joy,** vice president of research and development for Sun Microsystems: The majority of desktop machines in the year 2000 will run DOS or Unix. “In five years, most desktop machines will be replaced by laptops anyway.”

**Mike Swaveley,** president of Compaq North America: This decade will see a significant improvement in price-to-performance ratios for personal computers, which will be functionally built into the basic wiring of the home. PC technology will be part of the book, part of the appliance.”

**NEWS STAFF SEeks NEWS. DIAL (603) 924-9281.**

The BYTE news staff is always interested in hearing about new developments that might affect microcomputers, the way they work, or the way people work with them. If you know of a project that could shape the state of the art, please give us a call at (603) 924-9281 or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.
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BASIC Inventor Praises Gates

In his article, "The 25th Birthday of BASIC" (October 1989), Bill Gates hit two bull's-eyes. BASIC is a language whose purpose was, and is, to make it easy for beginners and others to write programs. And BASIC is here to stay.

As a teacher, I have been required to teach or know about such languages as Pascal, PL/I, FORTRAN, and C. Programming in BASIC for any problem is at least twice as simple. Like Bill Gates, I switch to BASIC (actually, True BASIC) when I have a tricky programming problem to solve.

The ANSI Standard for BASIC extends the areas in which BASIC is considered legitimate. The International Standard for BASIC (technically equivalent to the ANSI Standard) is in the final stages of its approval. It will soon be possible, for example, to distribute subroutine libraries written in Standard BASIC and expect that the recipients can use them anywhere in the world.

We at True BASIC join Bill Gates in wishing a long and productive life for BASIC.

Thomas E. Kurtz
True BASIC, Inc.
West Lebanon, NH

Genealogy of GUis

In "A Guide to GUis" (July 1989), Frank Hayes and Nick Baran say that the genealogy of early GUis (graphical user interfaces) was "straightforward: Researchers at Xerox's Palo Alto Research Center begat the Xerox Star; Steve Jobs visited PARC, saw the Star, went back to Apple, and begat the Mac."

Not so. It is wrong as to both chronology and personnel, as readers of BYTE will be aware ("Macintosh's Other Designers," August 1984). It should have said, "Researchers at Xerox's PARC begat the Xerox Alto; Jef Raskin visited PARC, saw the Alto, went back to Apple, and begat the Mac."

The Xerox Star came later. Jobs first visited PARC after the Mac project had already been conceived, and he didn't join the project until the Mac had been under development for about two years.

Jef Raskin
Pacifica, CA

Software Plays Catch-Up

What a shock it was to open my mailbox and see the September cover of BYTE—a 25-MHz 80486! Programmers are just now scratching the surface of the 80286.

Everyone is concerned with speed, but no one has written code that effectively uses the 80286 and 80386 chips. Hardware developers are at least four to six years ahead of the software developers.

Want to see a computer fly? Stop putting 8086-based software in an 80386 machine.

Wayne F. Brissette
Austin, TX

Enough Is Enough

Fred Langa's editorial, "Hip Deep and Rising" (October 1989), said something I've been waiting to hear for some time. Almost all the other computer magazines are trying to whip us into a feeding frenzy to buy all sorts of stuff. They got me. I just bought 2 megabytes of RAM when all I needed was 128K bytes.

Once the 80386SX was hailed as the greatest development in computer hardware since electricity, then it was the 33-MHz 80386, and now it's the 80486. These great revelations were made within months of each other.

The fact is that an "obsolete" PC AT in full battle dress has more than enough firepower to bludgeon its way through most office applications. The 80286 is

WE WANT TO HEAR FROM YOU. Please double-space your letter on one side of the page and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.
Great Moments in C-Programmer Evolution

"It's a jungle in there," said the programmer looking at the code for the user interface of an application. "Every year it gets worse."

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—Randy Jones, Beta Tester

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far from being dead.

Computer magazines need to focus on how to use the machines and software. I don’t think they understand what the average user does for a living. Many of BYTE’s articles are over my head, but trying to figure them out gives me a feel for the technology. I can now stand toe-to-toe with most technocrats on what counts—how to use the blasted things.

Michael Q. Gautier
Woodbridge, VA

Don’t Forget the Amiga
I find BYTE the most universally informative magazine of all the general microcomputer publications. However, it is straying into a straightjacket mentality of being not much more than “IBM World/Mac World.” BYTE seems to lack the generality it used to have.

A third computer is maturing into a solid and powerful alternative. It offers strengths in video and animation, as well as a genuinely multitasking operating system. This is, of course, the Amiga. BYTE has mentioned it in articles concerning multitasking, graphics, GUIs, and so on.

Perhaps you could publish an Amiga supplement. Thanks for your quality publication.

Jeff Johnson
Cincinnati, OH

Optical Opinions
Being in the optical drive business, I was particularly interested in your October 1989 Product Focus, “The Optical Option.” Although the article seemed fair, I thought that it was incomplete and that it stressed access time, data rate, and price too heavily.

Optical drives are at about the same stage of development as hard disk drives were 10 years ago. The technology is difficult, and the chip sets have not yet been developed.

Prices are high because sales are low, due to a developing marketplace. Access time and data rates are hindered by heavy optics and limited laser power. The good news is that all these factors are rapidly improving.

At Laserdrive, we concentrated on ease of use and reliability issues at the time of design, surpassing the competition in capacity and performance. The market is not static, and we are no longer tops in capacity, performance, or price. But I believe we are still the best in terms of reliability. We have recently made improvements in performance, cost, and packaging.

To judge design reliability, you might have listed some of the format variables, such as mark sizes, track pitch, and sector format. All optical drives have the potential for grown defects, and the method for handling these occurrences should be listed. You might have tested for data recoverability in the presence of added dust.

The servos for tracking, focus, spindle, and laser control are also important. Laserdrive uses servos that are adaptable to changing conditions. A few tests could reveal the ruggedness of the servos: operation during shock, vibration, temperature and humidity extremes, and high altitude. Of course, some of these tests are difficult to perform.

For WORM (write once, read many times) drives in particular, the method of interfacing the host system is important. Laserdrive uses WORM drives that are adaptable to changing conditions. A few tests could reveal the ruggedness of the servos: operation during shock, vibration, temperature and humidity extremes, and high altitude. Of course, some of these tests are difficult to perform.

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Now there's a battery-powered 286 with the one feature you've been waiting for.

That little package you've been expecting has just arrived. The Toshiba T1600. It packs a powerful 12MHz 286 microprocessor. One full megabyte of RAM that's expandable to 5MB. Plus your choice of 20MB or 40MB hard disk models. Equally impressive is its detachable, backlit EGA-compatible display, 1.44 MB 3½ inch diskette drive, and two expansion slots for access to an internal modem, LANs, mainframes and much more.

And since the T1600 is bound to spend a lot of time outside the office, we added some other important features.

Like AutoResume, which lets you restart your work wherever you finished. And space for two removable, rechargeable battery packs no larger than the palm of your hand. Which makes one thing about the T1600 unmistakably clear. It was definitely worth the wait.

Toshiba America Information Systems, Inc., Computer Systems Division

Circle 264 on Reader Service Card (DEALERS: 265)
OS/2, MS-DOS, Macintosh, and Digital Equipment systems.
Your readers should also consider the issues mentioned above.

Ted Rees
Chief Scientist
Laserdrive Ltd.
Santa Clara, CA

I enjoyed the articles on optical disks in your October issue. At my company, we are in the process of selecting optical disk units for our systems, so the articles were well timed.

Regarding the table on page 166, however, I think that the longer segments show better performance rather than the shorter ones, as the caption indicates.

Ray Liere
Oregon City, OR

The caption is wrong, and you are right. We're glad you liked the issue.—Eds.

Kudos for Unix/bin
I enjoyed David Fiedler's Unix/bin (August 1989). My knowledge of Unix is minimal, but my interest is high, and I look forward to future installments. I appreciate David's relaxed style and informative, anticipatory dialogue with the reader, and his sense of humor is not grounded in arrogance or cynicism—an increasingly rare phenomenon in technoprose these days. Good work.

Henry Sluder
Charlotte, NC

Don Crabb Asks Too Much
In his September 1989 Macinations column, Don Crabb asks Apple for much more than it can deliver, considering the hardware. Both Macintosh and MS-DOS computers have a simple single-tasking operating system that gives any application complete access to all system resources. If an application "goes wild," anything can happen, including corruption of the directory cylinder and any alternate directory cylinders with no regard to the device involved. Apple's System 7.0 does nothing to change this situation. The only safety measure for the masses is called a backup.

The review of the Sysgen Maxi RD45 ("Data to Go," September 1989) was interesting, but why not publish benchmarks that show the performance differences between the Mac and MS-DOS machines without the need to resort to a scientific calculator? It's possible to have both machines load and save a 5-megabyte file and publish those times instead of the mumbo jumbo you printed. Why not include both machines when you publish benchmarks concerning one or the other? You could use similar software in the tests, and the results would prove useful to someone making a purchasing decision. It's time to add a bit of fairness here, and BYTE ought to lead the way.

Michael J. Barton
Barre, VT

PPP Revisited
I chuckled when I read Peter C. Olsen's "Pachydermic Personnel Prediction" (September 1989). Working in the electronics industry as a manager of training, I recognized many of my coworkers in the article. I have one additional classification guideline. It's the standard I use when hiring a new employee for my department.

A training specialist would make graphs, flowcharts, diagrams, transparencies between the Mac and MS-DOS machines without the need to resort to a scientific calculator? It's possible to have both machines load and save a 5-megabyte file and publish those times instead of the mumbo jumbo you printed. Why not include both machines when you publish benchmarks concerning one or the other? You could use similar software in the tests, and the results would prove useful to someone making a purchasing decision. It's time to add a bit of fairness here, and BYTE ought to lead the way.

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A training specialist would make graphs, flowcharts, diagrams, transparencies...
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Palomar's Not the One

Thank you for mentioning Palomar Software’s contribution to Hewlett-Packard’s new DeskWriter printer (Short Takes, October 1989). However, Palomar did not write the driver shipped with the DeskWriter. Instead, we consulted with two Hewlett-Packard engineers, who wrote the driver based on a licensed copy of the Palomar Imaging Kernel.

Joel West
President
Palomar Software, Inc.
Oceanside, CA

CEBus Doing Just Fine

I’d like to comment on your Nanobits report on CEBus (October 1989). Rather than simply a specification for communication over the AC power lines in a home, CEBus defines a multimedia LAN for residential use. The network may comprise any combination of power line, twisted-pair, coaxial, and fiber-optic media, and it includes use of infrared and radio frequency devices for wireless applications. Your reporter visited the EIA Home Automation Booth at a recent Summer Consumer Electronics Show (CES) that demonstrated a network using five of these media.

While the booth was essentially unchanged from its first showing at the earlier Winter CES, it is unfair to suggest that little progress on the standard has occurred this year. In fact, the pace has been brisk in preparation for the interim standard. The fact that the demo occurred this year. In fact, the pace has been brisk in preparation for the interim standard does not imply that little has been accomplished.

Bob Garry
Design Engineer
Diablo Research Corp.
Sunnyvale, CA

Multiuser Support

I was disappointed that “The Multiuser Solution” (September 1989) did not include our product, Quick Connect/386. We believe Quick Connect/386 to be the premiere multiuser operating system on the market and worthy of inclusion in your article.

One significant aspect of multiuser software that you did not discuss is the ability to support multiple Hercules, EGA, and VGA workstations. Using hardware developed by companies such as AMR, Viewport Technology, and SunRiver, you can run DOS graphics applications (e.g., AutoCAD, Ventura Publisher, or Corel Draw) on workstations.

Ralph W. Swearingen
President, Virtual Systems
Walnut Creek, CA

Musical Prayers Answered

In the October 1989 Ask BYTE column, reader Ivo Busko of Baltimore expressed a desire to build a music synthesizer card using the Commodore sound interface device for the PC bus. That exact product, called the ISS-2001, is available from Innovation Computer, whose phone number is (414) 693-3416. The list price is $129.96. The ISS-2001 requires an external audio amplifier and speaker to operate.

Richard Zblocki
Innovation Computer Corp.
Cleveland, WI

Innovation sent us a version of its card, and we tried it out in the BYTE Lab on one of our PC clones. It’s easy to install, worked right out of the box, and can be controlled by GWBASIC.

—BYTE Lab staff

Compact Unix

Last summer, I had the opportunity to work at AT&T in its college internship program. While there, I was given an AT&T Unix PC Model 7300 to use as a dumb terminal hooked into the larger mainframes. At the end of the program, the company was going to dispose of the computer, so I asked the people in charge if I could have it to use at the college. They agreed.

Although it’s not manufactured by AT&T anymore, the Unix PC is still a very good computer. I wonder, however, how the AT&T engineers got the full Unix operating system on just a 10- or 20-megabyte hard disk. When I read about microcomputers using Unix today, I see that they require something like 100 megabytes worth of hard disk space to run Unix effectively.

Also, could you give me a contact at an AT&T service organization? I would like to call and find out if the company still supports the Unix PC.

Finally, I have a question related to the Intel family of microprocessors. I know what the difference is between the 8088 and the 8086, but what are the differences among the 8086, 80186, and 80286? All three have 16-bit processing and 16-bit data buses.

Kelecy L. Clarke
Fort Collins, CO

On the subject of the AT&T Unix PC, your confusion stems from your use of the phrase “full Unix system.” The actual operating-system kernel for Unix is quite small and in most cases can fit easily within 5 megabytes. Systems that you see today require lots of disk space for added utilities and files such as font definitions (which take up a lot of space) and all the support files for the X Window System. If you have the manual on-line, that can consume another 2 megabytes or so. Finally, a great deal of disk space can disappear at the hands of news or mail coming in through uucp.

You can still get a service contract for hardware support on the 7300. Contact AT&T Customer Systems Support, P.O. Box 8355, Iselin, NJ 08810. You can purchase hardware upgrades (e.g., memory and disk drives) from Discovery Electronics, 775 Franklin Rd., Suite 100, Marietta, GA 30067, (404) 425-5700.

Finally, on the differences among the Intel processors, we’ll take them in sequence. The 80186 is basically an 8086 with much of the external circuitry ordinarily found in 8086 systems brought on-chip. For example, the 80186 includes two DMA channels, a programmable interrupt controller, and three timers integrated with the CPU. The 80186 also boasts instructions not found in the 8086 instruction set (these new instructions are also supported by the 80286). Some of these new instructions are PUSHA and POPA—which transfer the entire register bank to and from the stack—and multibit shift instructions that accept an immediate value for the number of bits.

You are correct that the 80286 uses 16-bit registers and a 16-bit data bus; however, the 80286’s address bus is 4 bits wider than the bus on the 8086/80186. Hence, the 80286 can directly address up to 16 megabytes of physical memory. The 80286’s memory management is beefed up, too—it can access up to 1 gigabyte of virtual memory and provides memory protection through its protected virtual address mode.

—B. S. and R. G. continued
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More Write Protection
I am writing in response to the letter from Louis Robichaud in the September 1989 Ask BYTE. Robichaud asked about write-protecting a hard disk. There is at least one software alternative to the hardware solution you provided. NO-WRITE is available from Decision-Science Applications (1110 North Glebe Rd., Suite 400, Arlington, VA 22201, (703) 243-2500). It is available from Decision-Science for $50.

Joseph C. Krupp
Decision-Science Applications
Arlington, VA

Thanks for the information.
—BYTE Lab staff

Can’t Read Columns
I’m interested in accessing some numbers that are in four columns in a disk file, statistically manipulating them, and then writing them back to the disk. I can “crunch the numbers” with a hand calculator, but I am having difficulty getting a C program to access these columns.

L. Warren Rogers
Marina, CA

Assuming that I’ve read your letter properly, the C code to do what you need is easily constructed using the fscanf() function. Let’s say you’ve opened the file using the fopen() function, and the associated file pointer is in variable fpint. I’ll also assume that you’ve defined a character array string[80] and that the lines in your input file are no longer than 80 characters. The source code to read one line would look like this:

fgets(string,80,fpint);
sscanf(string, "%d %d %d %d", &val1, &val2, &val3, &val4);

and the numbers will be returned in the val variables. If your numbers are floating-point rather than integers, change the %d entries in the second line to %f.

—R. G.

Patents and Copyrights
Can a software program be patented? If so, what would the patent cover? The entire concept of using a gray-scale scanner to make color scans? The sequence of keystrokes used to write the program?
If software can be patented, why have leading companies chosen to copyright their programs, and not to patent them instead? Is it because a patent is public property and hence can be published, continued
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thus allowing anyone who has programming ability to create his or her own version.

If programs can be patented, what’s the implication for the computer software market? For example, could someone own one or more methods to make a post-erized image or a word processing program and thus “own” computer post-erization or word processing?

Norman Breslow
Los Angeles, CA

First, a word of warning: Patents are part of a complex area of law with its own jargon and a long history. Please don’t rely on anything we say here as legal advice; if you’re concerned that the program that you’ve written might have legal problems, you would be wise to consult a patent attorney.

Is it possible for a software program to be patented? No—the only thing that can be patented is an invention. However, if the invention is a computer algorithm, that invention could be made part of a piece of software. If the invention is a system that uses both computer software and hardware, the software could be part of the patented invention.

What is an invention? In simple terms, it’s a device or system that no one else has developed before. To be patented in the U.S., the invention must be both new and nonobvious—that is, it can’t be a device or technique that anyone competent in the field would normally come up with.

Patents aren’t as popular as copyrights (which are commonly used to protect programs) because patents are more expensive, require more effort to file for, take longer to get, and don’t last as long as copyrights. Under U.S. law, you normally have copyright protection the moment you create any original piece of work. You gain some additional rights by registering your copyright with the Library of Congress’s Copyright Office, but that’s just a matter of filling out a form and sending it in, with a small fee and a copy of the work (in some cases, just a portion of the work) to the Copyright Office. Under current copyright law, copyright protection lasts 50 years after the author’s death.

Getting a patent is a much more arduous process. First you must file an application with the U.S. Patent and Trademark Office. The application describes your invention in detail, including what part of the invention is actually new (and thus patentable), and it lists any earlier inventions that might prevent your patent from being issued. At the patent office, a patent examiner begins looking for the elements of your invention that already exist or have been previously patented. Your application might be rejected completely, or the scope of the patent might be narrowed considerably by the time it’s actually issued. And issuing a patent typically takes years or, in some cases, even decades.

Once the patent is issued, the description becomes part of the public record—thus, anyone can see how your invention works. It’s not retroactive; you have no patent protection until the patent is actually issued. And patent protection lasts a relatively short time—less than 20 years. But for the life of the patent, no one can use your invention without your permission. If someone comes up with the same idea, even independently, you have the right to collect royalties or forbid the person to use the invention.

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All Microsoft trademarks are acknowledged.
That’s a strong right, and in spite of the time and trouble it takes, more than a few companies have been awarded software patents. IBM has a large portfolio of them, which it licenses to many other companies—including its competitors. Apple has long used its patents on features of the Macintosh system software to discourage Mac clones. Recently, smaller companies such as Quarterdeck and QuickView Systems have been awarded patents on elements of their software.

Could you patent something as broad as word processing and thus own the market? It’s possible—one company recently sued Lotus, Microsoft, and other spreadsheet makers, claiming that it owns a patent that applies to all spreadsheet programs (that case will probably be in court for years to come). But, in general, patents tend to be pretty narrow in scope. And most patent owners are more interested in licensing their patents than in owning the market; after all, new inventions regularly make older patents obsolete. Look for a book called Legal Care for Your Software ($34.95) by Daniel Remer and Stephen Elias, due out in June from No To Press (950 Parker St., Berkeley, CA).—F. H.

He Lost His Memory
I have a Quadram ProSync EGA board, and one of the chips has burned out. It is labeled TMS 27C128JL LAP8705. Can you tell me where I can purchase a replacement chip?

Trang D. Nguyen
Clinton, MD

The 27128 is an EPROM chip. If you’ve burned out an EPROM chip on a graphics board, the odds are very good that you’re dead in the water. You’ll probably have to contact whomever you purchased the board from to see what sort of repair deal is available.—H. E.

Hard Disk, Please
Where can I purchase a hard disk drive controller card for a Tandy 1000EX? All the vendors that I’ve contacted will sell the card only as part of a complete hard disk setup.

Phil Cox
Cedar Rapids, IA

The Tandy 1000EX uses Plus cards, not XT or AT adapter cards. Also, Tandy does not officially support hard disk drives for the 1000EX. Consequently, unless you can find a third-party vendor that has a Plus card disk interface (or perhaps a Plus-card-to-PC-bus interface), it appears that you’re out of luck.—H. E. and R. G.

FIXES

- In “The BYTE Awards” (January), we inadvertently omitted Quicks’ PC Write 3.0, which received a BYTE Award of Distinction. As our nominating editor noted, the latest version of PC Write “does what you want it to do without costing two arms and a leg.” For $89, PC Write provides a full word processing program, complete with spelling checker. Our congratulations (and apologies for the omission) to Quicks.

- The price for OptionFinder (Regional What’s New, November 1989) was incorrectly listed. The correct price is $8995. Contact Option Technologies, 200 Carleston Ave., East Islip, NY 11730, (800) 645-2287 or (516) 277-7000.

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Surge Suppression
Dear Jerry,


Even if better surge suppression were added to the power supplies of my miscellaneous computer equipment, it would not reduce my reliance on external surge suppressors. Consider the fact that you had good reason to replace every surge suppressor that was on duty when the Great Surge hit. Now imagine replacing the power supplies in 50 diverse computers and peripherals.

Sure, each device could have a power supply designed with a replaceable surge-suppressor module. You would have to keep track down replacement modules as your computers, each from its own manufacturer. What if the maker has gone out of business? Or discontinued its seven-year-old printer's part?

Yes, I would welcome the extra protection. I simply wouldn't rely on it.

Guy R. Winters
Andover, MN

Yeah, I figured out why they don't put surge suppressors in the equipment just after the column went to press. Oh, well.—Jerry

Supercomputing
Dear Jerry,

Computing at Chaos Manor gives readers an excellent feel for the problems and solutions that are part of using computers. From my experience with computers, I know that whatever software you're using always works with every graphics card known to man except the one in your computer, or that the hardware you want to use requires a cable you don't have.

I spent a couple of years working with a computational fluid dynamics program, which was the base for a model of an industrial furnace. The CFD software, called Fluent, was lent to us by Creare, of Hanover, New Hampshire. Outside of military applications, I believe that our furnace model was one of the most comprehensive ever solved. The most powerful computer available to us was a VAXstation II running at about 1 million instructions per second and equipped with 16 megabytes of core memory. On our VAXstation, the model used several months of processor time to reach a solution, but then why should a workstation sit idle all night?

We ran the model on a commercial Cray II system for a while, but the costs were prohibitive. As you mentioned in a recent column, students are able to get 2 hours on a Cray through the National Center for Supercomputing Applications. For me, it was too little, too late, but the people at NCSA were very accommodating, and I would encourage any interested students to take advantage of the opportunity.

Most of the jobs that I use a computer for are mundane, such as word processing and making graphs. What do you think about the influence that Microsoft has had on the software industry in the last couple of years? I think that Windows has changed the way that people use their IBM-type computers. I was almost ready to switch to a Macintosh system to be able to produce camera-ready copy for my thesis. However, some excellent products, like Micrografix's Windows Draw, came along that made it easy for a non-artist like me to produce high-quality figures. Windows allowed me to switch back and forth between WordPerfect and Windows Draw, so I could print text and graphics without too much mental stress. Also, having Windows forced me to go out and buy a mouse, which I wouldn't be without now.

Since I often have Windows running, I prefer to use applications that are well behaved under Windows, which means that when I bought a spreadsheet, Excel

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."
Dear Jerry,

Over the years, I've read several of your philippics against Unix. Today I have time to write a letter, so I'm going to put my two bits in.

Most Unix debates, when parsed, are recognizable as religious disputes between cult insiders and cult outsiders. The position of the outsiders is, "If you would only believe in Unix, you would be saved from the twin demons of low productivity and ugliness." The position of the outsiders is, "I can manage my productivity a damned sight better than you can, and I spit on your aesthetic pretensions—get lost." Such conversations get really boring fast.

Unix has some outstanding prototyping tools—a bit too C-oriented for some tastes (including mine), but very useful nonetheless. It handles multitasking and many other jobs correctly (i.e., unobtrusively). It trains developers to think in terms of total system architecture instead of isolated chunks of code. Unix is beginning to show its age, but it is still a superb general-purpose development environment—I've yet to find a better one. By comparison, DOS is a flimsy toy that has never worked properly and never will, unless somebody like Borland can be talked into doing the job right.

Of course, there is another side to Unix. It is unspookingly bad as a production system. Training Unix users is expensive, and Unix processes have more overhead than New York has roaches. This is OK when the "users" are software engineers or students with a close connection to revenue, and when resource consumption is not controllable. But it's unacceptable when most of the users are data-entry clerks with a high rate of personnel turnover and when the same programs have been run in the same sequence every month for the last 20 years.

To accuse Unix of being a "system that requires... access to a wizard" is ignorant and unfair. I am not a wizard by any stretch of the imagination (my domain is financial software, and I usually run programs under DOS). I am only a software developer, but I love Unix—for development. You sometimes like to pose as a developer (hence the nice words for things like Modula-2), but you are only a software consumer, and you loathe Unix—for production. We're both right.

Why is it that the same crowd that sneers at sv and grep gets misty-eyed about the Norton Utilities' DS and NCD? The Norton Utilities (and FastBack, and DOS-16/M, and so on) are certainly superb, but the only reason they were written is that DOS was brain-dead at birth. The most depressing thing about DOS isn't that it needs prostheses, it's that the prostheses are better engineered than DOS itself, without exception.

William Matheson had great fun re-creating the speed of light in furlongs per fortnight (furl/fort) using the latest international standards (July 1989). Unfortunately, he too got tangled up in one of the subtle intricacies of the international standards picture.

He makes a big point of the difference between the international standard of 2.54 centimeters = 1 inch and the "U.S.-approved factor" of 39.37 inches = 1 meter. What he overlooks is that the U.S. has two standard conversions between metric and English linear measurements. For all purposes except land surveys, the standard conversion is the international value of 2.54 cm = 1 inch, but for land surveys it is the old 39.37 inches = 1 meter standard. And this dual standard is not as ridiculous as Matheson makes it sound.

Prior to the advent of international standardization, there were three conversion standards between metric and English units in different countries around the world, differing by a few parts per million. When the middle of the three (2.54 cm = 1 inch) was chosen for international standardization, the U.S. promptly considered converting from the old 39.37 inches = 1 meter standard. However, the Coast and Geodetic Survey just as promptly pointed out that the land survey system of the U.S. is based on triangulation from a carefully measured baseline near the East Coast and that benchmarks on the West Coast would be wrong by some 30 feet. Can you imagine the chaos if every benchmark in the U.S. had to be resurveyed and every land description and deed had to be changed to reflect the new survey? This conflict of needs held up the formal adoption of the international standard for a decade or more until finally the "two-standard" compromise was adopted. The compromise lets the U.S. be consistent with the rest of the world where consistency is needed (including the nautical miles mentioned by Matheson) without introducing a new gold mine for the legal profession in untangling our real estate descriptions.

Since the furlong is a land survey unit (one-eighth mile), the furl (U.S.)/fort speed unit must be different from the furl (international)/fort calculated by Matheson by the same 2 parts per million as the difference between the two conversion standards. Thus, using the 10-digit rounding of my calculator, the speed of light becomes 1,802,617,500,000 U.S. furl/fort, as compared to the similarly rounded international furl/fort value of 1,802,617,500,000.

John Laidig
Holmdel, NJ

International Standards

Dear Jerry,

William Matheson had great fun recalculating the speed of light in furlongs
Just three years ago, Compaq fired the shot heard around the world.
As PC technology has evolved, Compaq has been consistently among the first to tap its power. Now with the COMPAQ DESKPRO 486/25 and the COMPAQ SYSTEMPRO, Compaq brings new levels of performance to single and multiple users.

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The Intel 25-MHz 486 microprocessor is the heart of the system. Its breakthrough design integrates the processor with a numeric coprocessor (to speed number crunching) and an 8-Kbyte cache (to reduce wait states).

To boost performance further, Compaq added a second-level cache memory controller with 128 Kbytes of high-speed static RAM. Combined with interleaved memory architecture, it lets your data fly between the microprocessor and memory.

The 486 works in concert with COMPAQ Flex Architecture, which integrates a processor/memory bus with the new EISA I/O bus. This enables information to be processed at the highest possible speed while maintaining compatibility with 8-, 16- and powerful new 32-bit expansion boards.

The COMPAQ DESKPRO 486/25 is open for customization. Four megabytes of memory are standard, so you can run applications under MS OS/2 Version 1.2, MS-DOS or UNIX operating systems. If you need more, you can expand memory up to 100 megabytes using a separate high-speed 32-bit memory slot. That leaves up to seven EISA slots free for your choice of expansion boards.

You can work with up to seven internal storage devices, choosing from a range of high-performance, high-capacity fixed disk
drives (the 650- and 320-MB models have fast 1:1 interleave and ESDI controllers).

All told, you can store up to 1.3 gigabytes of data internally, or up to 2.6 gigabytes using the optional COMPAQ Fixed Disk Expansion Unit.

Compaq didn’t stop there. Accelerated VGA graphics are built in, giving you a crisp, colorful display and freeing an expansion slot. The system even has a socket for an optional Weitek 4167 coprocessor to blaze through calculations.

You can run the most complex CAD/CAM/CAE, scientific and business applications faster than ever before.

The COMPAQ DESKPRO 486/25. It’s sure to bring a little thunder to your office.
In September 1986, Compaq introduced a personal computer that changed people's ideas about what a PC could do.

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The COMPAQ SYSTEMPRO delivers an unprecedented combination of system performance and expandability to networks and multiuser systems. Its breakthrough design gives users the flexibility to work with both 33-MHz 386 and future 33-MHz 486 technology. It also provides the unmatched capability to work with multiple processors.

Inside both you'll find advances like cache memory designs that boost processor performance. Extended Industry Standard Architecture (Extended ISA or EISA) that accelerates input/output performance while maintaining compatibility. New drive and controller technology that increases fixed disk performance and reliability. And that's just the beginning of this story.
that will have business
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The multiple system processors are integrated into COMPAQ Flex/MP Architecture, which combines a separate processor/memory bus with the EISA I/O bus. EISA delivers the fastest I/O performance, which is critical for data sharing.

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It simply works better.
Laptops Get Lighter

Copam’s 286LT and 386SXLT are inexpensive laptops with 12-MHz 80286 and 16-MHz 80386SX microprocessors, respectively. Each weighs 12 pounds with the battery, and a battery quick-charger for 2-hour charge times weighs another 3 pounds.

Both systems feature back-lit VGA screens and nickel-hydride batteries with 40 percent more efficiency for their weight than nickel-cadmium batteries, Copam claims. Each system includes a Phoenix BIOS, 1 megabyte of RAM (expandable to 4 megabytes), a 91-key keyboard, two full-length EISA slots, a Phoenix BIOS, and a driver for VGA color graphics. One option is a 100-megabyte hard disk drive.

The 20-MHz 80386 comes with a monochrome VGA display, 2 to 8 megabytes of RAM, and a Phoenix BIOS. The 80386SX, with the standard 16-MHz clock speed, includes 1 to 8 megabytes of RAM. All three systems measure 4½ by 15 by 16 inches.

Price: 286LT, under $2000; 386SXLT, under $3000.
Contact: Copam USA, Inc., 45875 Northport Loop E, Fremont, CA 94538, (415) 623-8911.
Inquiry 1120.

Portable

EISA 80486

With Color Monitor

Micronics Computers has introduced the MP400 Series of portables, which includes an Extended Industry Standard Architecture (EISA) 80486 with an optional VGA color LCD monitor.

The 25-MHz 80486 system comes with 2 megabytes of RAM (expandable to 16 megabytes), a 40-megabyte hard disk drive, a 91-key keyboard, two full-length EISA slots, a Phoenix BIOS, and a driver for VGA color graphics. One option is a 100-megabyte hard disk drive.

The 20-MHz 80386 comes with a monochrome VGA display, 2 to 8 megabytes of RAM, and a Phoenix BIOS.

Price: 80386SX, $3800; 80386, $4500; 80486 monochrome, $7500; 80486, color, $10,000.
Contact: Micronics Computers, Inc., 935 Benecia Ave., Sunnyvale, CA 94086, (408) 732-0940.
Inquiry 1121.

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Price: $1899.
Contact: Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759, (512) 338-4400.
Inquiry 1123.

Commodore’s

Multimedia Amiga

The Amiga 2500/30 features custom sound, animation, and graphics chips in a 68030 system for multimedia presentations. There are also options for DOS and Unix hardware and software compatibility.

The 2500/30 comes with a 25-MHz 68030 processor and 2 megabytes of 32-bit RAM, expandable to 4 megabytes. It also has a 25-MHz 68882 math coprocessor, a 68851 memory management unit, a 3½-inch 880K-byte floppy disk drive, a 40-megabyte hard disk drive, and an auto-booting hard disk drive controller. Ports include one parallel, one RS-232C serial, and two RCA-type audio output jacks for stereo sound.

Expansion slots include two XT, two AT, five Amiga, and one video slot. Two optional XT and AT bridgeboards let you add DOS and Unix hardware and software through Amiga’s multi-tasking operating system. The 4.77-MHz 8088 bridgeboard has 512K bytes of RAM; the 8-MHz 80286 bridgeboard has 1 megabyte of RAM.

Price: $4699; 8088 bridgeboard, $699; 80286 bridgeboard, $1599.
Contact: Commodore Business Machines, Inc., 1200 Wilson Dr., West Chester, PA 19380, (215) 431-9100.
Inquiry 1122.

continued
Mac-Compatible Dictionary-Size Printer from Kodak

The Diconix M150 Plus is a thermal ink-jet printer for Macintosh portables that weighs 3/4 pounds, including its five C-size rechargeable batteries. About the size of a desk dictionary, the printer connects to a serial port and transmits at 9600 bps.

An Adobe type manager has 13 outline fonts, and you can use all the Adobe standard type-1 fonts, according to printer driver. The easily replaceable print head with its self-contained ink supply delivers a resolution of 192 dpi in quality mode and 96 dpi in draft mode and can print up to 500 pages in draft mode before you need to change it.

Price: $699.
Contact: Eastman Kodak Co., 901 Elm Grove Rd., Rochester, NY 14653, (800) 255-3434 or (716) 253-0033.
Inquiry 1126.

MicroLaser Offers Low Price, Speed, and PostScript

The MicroLaser from Texas Instruments is a 6-ppm laser printer that comes standard with LaserJet emulation. Its 512K bytes of RAM is expandable to 4.5 megabytes.

A PostScript upgrade for the MicroLaser requires installation on the removable motherboard. Two versions are available: one with 13 fonts, and one with 35 fonts.

Price: $1999; 13 PostScript fonts, $3000; 35 fonts, $3500.
Contact: Texas Instruments, Data Systems Group, P.O. Box 202230, DSG-290, Austin, TX 78720, (800) 527-3500.
Inquiry 1128.

High-Capacity Laptop and Notebook Drives

If you’re on the road with data-intensive applications, you may need Areal Technology’s 200-megabyte laptop hard disk drive, the BP-200, or the 100-megabyte notebook-size hard disk drive, the MD-2100.

The BP-200 is a 3½-inch drive that features a single glass disk for storing up to 200 megabytes of formatted data in what the company says is the highest data density ever achieved—142.5 megabits per square inch. Average access time is rated at 29 ms. The use of glass rather than aluminum produces a flatter disk surface, allowing the read/write heads to fly as close as 4 microinches to the spinning disk surface, Areal reports.

Other BP-200 specifications include a 2500-track-per-inch storage format, a weight of 8½ ounces, and a rotation rate of 1600 rpm.

The MD-2100 is a 2½-inch drive that’s barely three-fifths of an inch thick, has an average access time of less than 29 ms, and can sustain a transfer rate of 7.5 megabits per second, Areal claims. It requires only 5 V of input power and weighs 4½ ounces. The actual dimensions are ¾ by 2¼ by 4 inches.

Price: BP-200, $995; MD-2100, $995.
Contact: Areal Technology, Inc., 2890 North First St., San Jose, CA 95134, (408) 954-0360.
Inquiry 1127.

Mac Portable Power for the Road

Two products from Lind Electronic Design help power your Mac Portable. A 12-V DC Power Adapter charges your Mac’s internal battery using a 12-V source. The adapter weighs three-quarters of a pound and measures 2 by 3 by 8 inches.

The External Battery Charger recharges your Mac’s spare battery using any 115-V AC or 12-V DC power source. The 1½-pound unit, which measures 3 by 6 by 7 inches, will charge your spare battery to 80 percent of capacity in 3 hours.

Price: DC Power Adapter, $69.95; External Charger, $99.95.
Contact: Lind Electronic Design Co., Inc., 6416 Cambridge St., St. Louis Park, MN 55426, (612) 927-6303.
Inquiry 1130.

Monitors for 8514/A-Compatible Applications

The Ultra II is a 14-inch color monitor with a resolution of 1024 by 768 pixels. It’s compatible with the IBM XT, AT, and PS/2s, and Mac SEs and IIs. It’s also compatible with the latest graphics standards, from 8514/A down to MDA.

Autosynchronous scan frequency ranges from 15 to 55 kHz horizontal and 45 to 120 Hz vertical scan. The dot pitch is 0.26 mm. Video bandwidth is 70 MHz.

The CRT is a 14-inch diagonal Trinitron tube. Inputs can be analog video, synchronous analog, or TTL synchronous.

The Ultra X, which is available in 14-, 16-, and 19-inch color and monochrome versions, features multiple resolution support and memory support from 512K bytes to 8 megabytes.

It also features a Virtual Screen, which lets you access a screen that’s much larger than the display resolution of the monitor. The Ultra X resolutions range from noninterlaced 512 by 512 pixels to VGA to an interlaced 1280 by 1024 pixels.

All five Ultra X models include a low-resolution controller, a monitor, a keyboard, and a mouse. The base model is a monochrome edition; the luxury models include color analog with 16 simultaneous colors. Bandwidth is 80 MHz.

Contact: Princeton Graphic Systems, 1100 Northmeadow Pkwy., Suite 150, P.O. Box 100040, Roswell, GA 30076, (800) 221-1490 or (404) 664-1010.
Inquiry 1129.

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**db_VISTA III from Raima** combines the flexibility of a relational DBMS and the lightning speed of the network database model.

**db_VISTA III is written for C Programmers.** Source code available.

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386/25 WORKSTATION $4,395.00
80386 25 MHz system board with 32 KB static cache
80387 25 MHz Math Coprocessor INCLUDED
4 MB SIMM RAM
ATI VGA Wonder Card/512K 1024 x 768 res.
ATI Bus Mouse
NEC Multisyn 3D Color Monitor 1024 x 768 res.
150 MB ESDI Hard disk
1.2 MB 5.25" floppy drive
1.44 MB 3.5" floppy drive
ESDI hard disk/floppy drive controller
2 serial, 1 parallel and 1 game ports
Vertical case
101 Enhanced keyboard
MS/DOS 4.01
AMI BIOS with full MS DOS, OS/2, SCO Xenix, Novell, 3COM and PCNET compatibility

386/20 WORKSTATION $2,695.00
80386 20 MHz system board
1 MB SIMM RAM
ATI VGA Wonder Card/256K
NEC Multisyn 2A Color Monitor 800 x 600 res.
80 MB Seagate Hard disk
1.2 MB 5.25" floppy drive
1.44 MB 3.5" floppy drive
1:1 interleave hard disk/floppy drive controller
2 serial, 1 parallel and 1 game ports
Vertical case
101 Enhanced keyboard
MS/DOS 4.01
AMI BIOS with full MS DOS, OS/2, SCO Xenix, Novell, 3COM and PCNET compatibility

286 LCD PORTABLE $1,395.00
80286 12 MHz 0 wait states system board
AMI BIOS
640 KB RAM expandable to 4 MB
1.2 MB Floppy drive
40 MB Hard disk (28ms)
Color graphic card with
External CGA/Mono adaptor
640 x 200 LCD screen
2 serial, 1 parallel and 1 game ports
86 keys keyboard
200 Watts 120/220v power supply
Padded soft carrying bag
Weight: 22 lbs.
Size: 16" x 9" x 7"
LCDD400 with 640 x 400 High Resolution screen available
LCDEGA with 640 x 400 EGA LCD screen available

286 CRT PORTABLE $1,195.00
80286 12 MHz 0 wait states system board
AMI BIOS
640 KB RAM expandable to 4 MB
1.2 MB Floppy drive
40 MB Hard disk (28ms)
Mono graphics card
2 serial, 2 parallel and 1 game ports
86 keys keyboard
200 Watts 120/220v power supply
3 slots available
Weight: 26 lbs.
Size: 17.25" x 19" x 7"

286 CRT EGA Mono $1,295.00
EGA gas plasma screen 720 x 400
286-12 MHz 0 wait 640K Ram
1.44 MB floppy drive
40 MB Hard disk (28 ms)
2 serial 1 parallel
86 key keyboard
180 watt power supply
Carrying bag
Weight: 16 lbs.
Size: 16" x 9" x 5½"

286 gas plasma mini portable $1,945.00
EGA gas plasma screen 720 x 400
286-12 MHz 0 wait 640K Ram
1.44 MB floppy drive
40 MB Hard disk (28 ms)
2 serial 1 parallel
86 key keyboard
180 watt power supply
Carrying bag
Weight: 16 lbs.
Size: 16" x 9" x 5½"

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CAF has been selling computers and laptop systems in Europe for years and now CAF has finally arrived. Simple and Efficient design combined with superb Engineering give CAF computers the reliability and power no other computer can beat.

Judge a 'Board' From its Cover

All CAF computer system boards are manufactured using Surface Mount Technology – one of the most advanced technology in circuit board manufacturing industry, thereby providing the dependability you can count on. After all, if you don't like the cover, why bother to open it?

More to Come . . .

The wave of 486's are coming, and CAF Are ready for it. CAF are introducing five new products shortly. These include a 486 workstation, a 486 accelerator board for existing 386 computers, a 80C86 battery computers in a size of a book, and finally, a SCSI Host adapter for AT's in both the MCA and EISA architecture.

CAF ProLITE 286/16 $2,495.00

80286 16 MHz 0 wait states system board
AMI BIOS
10.25" Gas Plasma screen
720 × 400 resolution, 4 level gray scale
EGA graphics card with external adaptor
1 MB RAM expandable to 8 MB
1.44 MB Floppy drive
40 MB Hard disk (Connor, 28ms)
1 serial, 1 parallel ports
External Floppy drive and keyboard connectors
Padded soft carrying bag
Weight: 16 lbs.
Size: 15" × 14.25" × 3.5"
Software: MS-DOS 4.0 GW basic, silk

CAF MASTER 286/20S $1,375.00

80286 20 MHz 0 wait states mono system
CAF MASTER 386SX/16S $1,845.00

80386SX 16 MHz 0 wait states system board
AMI BIOS
1 MB SIMM RAM expandable to 8 MB
1.44 MB Floppy drive
40 MB Hard disk (28ms)
2 serial, 1 parallel ports
External Floppy drive connectors
101 keyboard
VGA 14" Color Monitor
3 slots available
Software: MS-DOS 4.0 GW basic

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**EISA Performance Betters Sampling Rates**

The National Instruments EISA-A2000 is a data acquisition board that uses DMA and associated software to functionally double the data acquisition performance of Industry Standard Architecture-based systems, the company claims.

The EISA-A2000 samples analog signals at rates of up to 1 million samples per second, digitizes the samples with 12-bit resolutions, and then sends the data directly to memory.

The EISA-A2000 also features four analog input channels for simultaneous sampling. Each channel has its own sample and hold circuitry, and each can operate at 1 million samples per second; two channels can operate simultaneously at 500,000 samples per second, or four channels can operate simultaneously at 250,000 samples per second, according to National Instruments.

Other hardware features include: pre-, post-, and delay triggering; a real-time system integration bus for routing timing and triggering signals between multiple data acquisition boards; bus bandwidth optimization (but not bus mastering), EISA burst-mode support, software-controlled configuration and calibration; and oscilloscope emulation.

VisionScope and DOS LabDriver software give you, respectively, oscilloscope emulation for easy capture and storage of waveforms, and programming functions that enable you to call functions from Microsoft C or QuickBASIC to control the board. Another software feature, LabWindows, gives you intuitive interfaces (called function panels) for interactively configuring and controlling programmable instruments and data acquisition boards.

**Bus-Mastering EISA Board Controls Disk Drives**

The hyperStore•1600 dual-mode caching disk drive controller division has introduced a bus master drive controller that offers interfaces for four ESDI drives. Optional interfaces on the DTC6280SE-15C board support four floppy disk drives and up to seven SCSI drives (through one SCsi connection). The board includes 1 megabyte of RAM and offers full 32-bit bus support with burst mode at 33 MHz. It also includes up to 4 megabytes of onboard cache memory.

**Disk Caching for Multiple Operating Systems**

The hyperStore•1600 dual-mode caching disk drive controller features state-of-the-art performance and compatibility with DOS, Xenix/ Unix, NetWare, OS/2, Pick, QNX, and other operating systems. It works off an XT or AT slot with a 16-bit Z80 microprocessor and includes two I/O ports per card and a dual-drive floppy disk drive controller for 5¼- and 3½-inch drives.

Hard disk performance enhancement is possible with 512K bytes of cache memory, expandable to 4 megabytes on the board and up to 20 megabytes of cache with Perceptive Solutions' 16-megabyte expansion card.

Data transfer is rated at more than 2.5 megabytes per second with 4-megabyte-per-second bursts. Average data access is rated at 0.28 ms.

Each hyperStore controller works with Perceptive Solutions' Mediadapter for compatibility with drives that need modified frequency modulation, run-length limited, ESDI, or SCSI. The hyperStore can support up to four Mediadapters per controller.

**Western Digital Makes MCA-Compatible 8514/A**

Western Digital has expanded its Paradise graphics controller line to include three 8514/A graphics cards.

The new Paradise 8514/A Plus Card works in AT-bus machines. With 512K bytes of on-board RAM, it can generate 16 colors at a resolution of 1024 by 768 pixels on interlaced or noninterlaced monitors. With an additional 512K bytes on a daughtercard, the Paradise card can generate 256 colors at 1024 by 768 pixels.

The company has also announced a version of the Paradise 8514/A for the Micro Channel. And the Paradise 8514/A Plus Combo Card, which incorporates both 8514/A and VGA support in an AT card, will let you access either VGA or 8514/A graphics through software and even change from one to the other as if there were two cards, the company says.

**Continued**
You're on a crash course. Let Verbatim back you up.

Even faster than your data has been stored, it can disappear. Wiping out invaluable time, effort and dollars. That's why you need to back up your data with Verbatim®.

Verbatim offers a line of products unique in safeguarding data. Like its exclusive DuPont Teflon® coating. And DataHold™ anti-static liners. Plus, a technologically advanced manufacturing process that assures every diskette is perfect.

Verbatim was also first to offer factory formatting to save you time. And lifetime warranties on every product. There are even color diskettes for easy organizing. Continuing Verbatim's history of providing new products with distinct user benefits.

So stay on course. Let Verbatim back up all your data. For more data on Verbatim, call 1-800-538-8589.

* Teflon is a DuPont registered trademark.
Chart Viewer Navigates the High Seas

Chart Viewer is an 8-MHz 8086-based computer that displays National Oceanic and Atmospheric Administration (NOAA) navigational charts on an LCD screen. It receives Long Range Radio Navigation (LORAN) information through cables and a connector to your on-board LORAN device, and Global Positioning System and Satellite Navigation information through a direct radio link.

You use Chart Viewer by selecting your destination and pressing the Enter key. This creates a waypoint. When you select the second waypoint, Chart Viewer automatically draws a line between them. You can save up to 3000 way-points on a single chart disk. Other features include pull-down menus, a zoom feature with 10 levels of enlargement, and a LORAN feature for dead reckoning.

The charts are available on 3½-inch 1.44-megabyte floppy disks from In Focus Systems. You use Chart Viewer by selecting your destination and pressing the Enter key. This creates a waypoint. When you select the second waypoint, Chart Viewer automatically draws a line between them. You can save up to 3000 way-points on a single chart disk. Other features include pull-down menus, a zoom feature with 10 levels of enlargement, and a LORAN feature for dead reckoning.

The charts are available on 3½-inch 1.44-megabyte floppy disks from In Focus Systems. Chart Viewer’s LORAN accessory charts your nautical course and is PC compatible.

JetWriter Lets Macs Print on HP’s LaserJet

If you’ve been put off by the price of an Apple LaserWriter, you can now connect your Mac to the Hewlett-Packard Laserjet IIP. JetWriter includes a board for the printer and software drivers. The software drivers convert Macintosh QuickDraw files to HP’s Printer Control Language. The product includes a high-speed interface board that replaces the serial interface in the LaserJet IIP.

The JetWriter interface operates at 230,400 bps as opposed to the standard 19,200 bps speed of the serial interface. But the interface is not AppleTalk-compatible, and a LaserJet IIP with JetWriter cannot be used in an AppleTalk network, although the companies claim that’s in the works.

JetWriter supports Adobe Type Manager but not PostScript.

Price: $345.
Contact: Insight Development Corp., 2200 Powell St., Suite 500, Emeryville, CA 94608, (800) 825-4115 or (415) 652-4115.
Inquiry 1142.

Chameleon Simplifies Macros for PCs and Macs

The Chameleon Keyboard Customizer plugs into your XT- or AT-compatible keyboard port and stores about 3000 keystrokes in macro commands.

You can represent multiple keystrokes with one keystroke in any combination of keys, including Alts, Shifts, and Controls.

The XT and AT versions automatically intercept keyboard messages, giving you EPROM storage. The serial and DEC-compatible versions, Sirius says, will need about 25K bytes of system memory.

Price: $59.
Inquiry 1143.
Lotus... the acknowledged industry leader in providing essential business software. The Lotus family of products work together to help you gather, analyze, present and communicate information, offering a complete solution to your business software needs.

As a direct dealer, Programmer's Paradise stocks the entire Lotus product line, as well as thousands of other software products. Programmer's Paradise... your one-stop software source.

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Lotus Freelance Plus 3.01
It's easy to see why Software Digest, InfoWorld, PC Week and PC World recently proclaimed the new Freelance Plus the number one business graphics package. Freelance Plus gives you the complete charting and drawing tools you need to make quick work of creating great presentations. It offers unparalleled links to 1-2-3, making the sharing of information across applications easy, and it's the only business graphics package that provides a "live link" to the 3-D worksheets in 1-2-3 Release 3.0. There's no easier way to create business diagrams, like flow charts, that communicate concepts and ideas. Or to enhance your graphics with symbols and maps. Create your own illustrations and logos, and incorporate scanned images into your graphics. To find out what a graphic difference it can make in your work, call today for your FREE Freelance Plus Demo Disk.

Lotus 1-2-3 Release 3.0
If you want a spreadsheet that can make your computer work to its fullest, we have one thing to say: More power to you. And that's exactly what Lotus delivers with this breakthrough in spreadsheet technology. Its new true 3-dimensional design lets you organize, analyze and navigate your way through large and complex spreadsheet applications with incredible speed, power, and ease. Equally impressive is Release 3.0's presentation quality output, its selection of advanced analytical graphics and its new relational database capabilities. And Release 3.0's fully customizable.

Lotus Magellan
If you're tired of looking for specific information somewhere on your PC, and you don't feel like searching every directory or loading and unloading every file to find it, we have exactly what you need. Lotus Magellan. Lotus Magellan is the first PC utility to help you find your files by letting you instantly see their contents as they appear in your favorite applications. Unlike other programs, the Magellan Explore function can perform a search on a phrase, topic, idea or even an entire file. Not just key words. When you've found out what you need, you can Launch directly into the application that created the file. You also have the option of Gathering information from several files—even from different applications—and compiling it into a single file that you can use right away. See the special offer below to receive a trial copy today.

Lotus 1-2-3 Release 2.2
Now, without changing what's made it the best, we've made it even better. Release 2.2 brings you the most wanted features that seasoned 1-2-3 users have been asking for. Its 2-D spreadsheet includes file linking, minimal recalc, and UNDO error correction. Plus many other power options—like new macro commands, Learn automatic keystroke recording, and the Macro Library Manager. And you'll find improved graphics and precision-quality output thanks to Allways, the spreadsheet publishing add-in that's now part of Release 2.2.

THE LOTUS PRODUCT LINE

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<th>Product Name</th>
<th>LIST</th>
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<td>350</td>
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<td>Fujitsu/PLUS Programmer</td>
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<td>EP/Force</td>
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<td>FileMaker</td>
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<tr>
<td>ProFit</td>
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<td>ProgCom</td>
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### DEBUGGERS

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### DOCUMENTING/FLOWCHARTING

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### EDITORS

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<td>Turbo Builder</td>
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<td>Turbo Builder PLUS/5.0</td>
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<td>Turbo Pascal 5.5</td>
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<tr>
<td>Turbo Pascal 6.5</td>
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### FORMATTING

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### GRAPHICS LIBRARIES

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<td>Essential Graphics</td>
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<td>FontTools</td>
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<td>Graphic.MENU</td>
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<tr>
<td>Data Entry Design</td>
<td>99</td>
<td>83</td>
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<tr>
<td>Data Entry Module</td>
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<tr>
<td>Graphic-Menu Desktop Toolkit</td>
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<tr>
<td>HALO</td>
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<td>HALO Plus Windows Toolkit</td>
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<tr>
<td>Icon-ToolPlus</td>
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<td>MetaTool</td>
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<td>MetaTool Plus</td>
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<td>PCX Effects</td>
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<tr>
<td>Programmer's Toolkit</td>
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### LINKERS/LIBRARIES

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<td>RTLink</td>
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<td>RTLink/Plus</td>
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### MODULA-2

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<tr>
<td>LOGITECH Modula-2: Compiler Package</td>
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<td>75</td>
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<td>Development System</td>
<td>249</td>
<td>195</td>
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<tr>
<td>TurboModula-2 Programmer's Toolkit</td>
<td>149</td>
<td>119</td>
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<tr>
<td>B-Tree Toolkit</td>
<td>149</td>
<td>119</td>
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<tr>
<td>Communications Toolkit</td>
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<tr>
<td>Compiler</td>
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<td>DOS Pack</td>
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<td>Teclink</td>
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### NETWORK PROGRAMMING

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<td>Novell C Network Compiler</td>
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<td>Novell C Network Compiler/386</td>
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<td>dBASE IV/PLUS Network</td>
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<td>Pantel LAN</td>
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<td>Remote Procedure Calls</td>
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<td>XDB-Server</td>
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### PASCAL LANGUAGE

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<td>Turbo Pascal 5.5</td>
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<td>Turbo-Plus 5.5</td>
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### PROTOTYPING

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<td>MailPlus</td>
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<td>MailPlus PLUS</td>
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### WINDOWS (MS) TOOLS

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<th>Description</th>
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<td>795</td>
<td>650</td>
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<td>C-TalkWindows</td>
<td>450</td>
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<td>dBase/Windows</td>
<td>249</td>
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<tr>
<td>MS Windows Development Kit</td>
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<tr>
<td>RFlow</td>
<td>79</td>
<td>65</td>
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<tr>
<td>WhiteWave Resource Toolkit</td>
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<td>WinRelieve</td>
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### ADDITIONAL LANGUAGES

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<td>Meridian AIDStudent</td>
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<td>Meridian AID Developer's Kit</td>
<td>1050</td>
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<td>Personal Rexx</td>
<td>150</td>
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<td>Smalltalk/386</td>
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<td>Smalltalk/80</td>
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<td>Smalltalk/286</td>
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### NEW RELEASES

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<tr>
<th>Description</th>
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<tr>
<td>MS OS/2 Presentation Manager Toolkit</td>
<td>Updated to support the new capabilities of OS/2.2. Color and contrast icons from a 256 color palette. Dialog box editors now support multi-line edits and pop-down list boxes. Resource Compiler gives you greater control of the look of menus and dialog boxes.</td>
<td>List: $500</td>
</tr>
<tr>
<td>RFlow by RFF Electronics</td>
<td>Professional flowcharting for Microsoft Windows. Over 75 shapes to work with that automatically adjust in size as you enter text. Supports all standard Windows paint and printers and plotters. Move flowscharts to other Windows applications via the Clipboard.</td>
<td>List: $79</td>
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### RFP by Pocket Soft, Inc.

<table>
<thead>
<tr>
<th>Description</th>
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<tr>
<td>RFP by Pocket Soft, Inc.</td>
<td>Updated with new multi-line edits and pop-down list boxes. Resource Compiler gives you greater control of the look of menus and dialog boxes.</td>
<td>List: $495</td>
</tr>
</tbody>
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Programmer's Paradise

(800) 445-7899

MORTICE KERN SYSTEMS
MS AWK 99 85
for DOS and OS/2
MS LEX/YACC 249 209
for DOS and OS/2
MS MAKE 149 129
for DOS and OS/2
MS Programming Platform 665 565
for DOS and OS/2
MS RCS 189 159
for DOS and OS/2
MS Software Mgmt. Team 299 255
for DOS and OS/2
MS Tools 249 209
for DOS and OS/2
MS VI 149 129
for DOS and OS/2

NOVELL
Browse Single-User 245 185
Browse for DOS 3.1 Networks 595 449
Browse for OS/2 595 449
C Network Compiler 665 525
C Network Compiler/386 995 795
NetWare C Interface for DOS 295 239
NetWare MHS 100 79
NetWare MHS Interface Guide 149 125
NetWare RPC/FORTRAN 149 125
NetWare RPC for OS/2 595 449
NetWare SQL 595 449
NetWare System Calls for DOS 195 159
SIDEPLUS 195 159
ST PLUS 195 159
STYLE PLUS for OS/2 595 449

POLYTOON
Dan Bricklin's U20 195 159
Personal VPCs 149 125
PrintFiles 495 419
PolyAWK 99 85
PolyDex 199 169
PolyLibrarian 99 85
PolyMake 149 125
PolyMake 99 85
Professional VPCs 500 409

SOUTH MOUNTAIN SOFTWARE
Breakout II 125 99
C Utility Library 199 159
Essential C 95 79
w/scope 95 79
Essential Communications 249 199
Essential Graphics 299 239
w/GUIDE 95 79
GUIDE 95 79
Hold Everything 129 109
President CY 99 79
w/scope 99 79
Screen Star 99 79
w/scope 99 79
ZORTECH
ZorTech C Video Course 500 449
ZorTech C Compiler 200 165
w/Source 300 255
ZorTech C Compiler/2 150 129
ZorTech C++ Developer's Ed. 450 399
ZorTech C++ Tools 150 129
ZorTech C++ Video Course 500 449

Programmer's Policies

Phone Orders
Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express, Discover. Include $4.00 per item for shipping and handling. All shipments by UPS ground. Rush service available.

Mail Orders
POs by mail or fax are welcome. Please include phone number.

International Service
Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts
Call for information.

Unbeatable Prices
We match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy
30-day no-hassle return policy. Some manufacturer's products cannot be returned after even though they have been made available to the user.

CASEW
Save Weeks in Windows Development Time
CASEW is a development tool that utilizes a high-level prototypy design the Windows portion of an application, and an Export System to generate the Windows program source code in the "C" language.

Programmers add their program functionality directly to the source code framework that was created with CASEW.

CASEWORKS has a "Code Management Facility" that allows the developer's added code to be preserved even after changes have been made to the interface.

List: $795 Ours: $759

The FairCom Toolbox

Don't struggle choosing between a 4GL or C. The FairCom Toolbox, with its development environment by d-tree™, file management by c-tree™ and report generation by c-tree™ integrates performance, productivity, and profitability into one industrial strength package.

Features include prototype generation, data dictionary, resource switching,screen management, overlapped windows, file restructuring, code portability, menu management, portable code records, compression, client/server architecture, dynamic space reclamation, and complex multi-line reports with total runtime layout control.

Try the FairCom Toolbox risk free for 30 days.

Special Edition
List: $695 Ours: $549
Professional Edition
List: $1,095 Ours: $869

Essential Communications Library

Essential Communications is a powerful asynchronous communications library stressing reliability and ease of use. The library supports interrupt driven communications for up to 14 ports at speeds up to 115,200 baud. The library supports XON/XOFF, XMODEM (CRC and Checksum), XMODEM-1K, XMODEM Batch, YMODEM-g and Kermit. True background communications and multiple concurrent sessions are supported. Support for Hayes compatible modems is provided.

All source is included. Clear and concise documentation. No royalties. Borland Turbo C & Microsoft C/Quick C compatible.

List: $249 Ours: $199

PANEL Plus II

Now available with full source, the latest release of this reliable, time-tested screen design product includes an interactive screen design editor, C and FORTRAN code generators, and an extensive library of user-interface functions. The library functions include virtual screen, scrolling windows with mouse-controlled scroll bars, pop-up and pull-down menus, and support for popular graphics libraries. All versions of PANEL Plus II include full library source, allowing your applications to be ported royalty-free between DOS, OS/2, Unix, VMS and other operating systems. The new Utility Source License option also allows you to develop software using PANEL Plus II on any suitable system with a C compiler.

List: $495 Ours: $395
With Utility Source: $1,195 Ours: $955

A Division of Voyager Software Corp.
1163 Shrewsbury Ave., Shrewsbury, NJ 07702.

Circle 210 on Reader Service Card
DynaComm Optimizes Software for Windows

Future Soft Engineering's DynaComm Asynchronous Edition 2.1 is a communications software package for Microsoft Windows. The company says that it supports CompuServe B+, XMODEM, YMODEM, YTerm, and Kermit. It also supports many terminal emulations, including HP 700/94, DEC VT52, VT100, VT220, IBM 3101, TeleVideo 925/950, Vidtex, and ADDS VP-60. Recent additions include support for NetBIOS, UBNetCI, ComBios, and Device network interfaces.

A communications manager, Director, integrates the functions of a phone dialer and also lets you execute scripts created with DynaComm's script language. With 275 tools, you can create scripts to handle most communications tasks, such as dialing and logging onto BBSes, which you can subsequently execute by clicking on icons with a mouse.

Other additions include support for Digital Equipment's LAT protocol and multichannel capabilities that let DynaComm net multiple servers and multiple clients at the same time.

A built-in text editor has several functions, including wrapping text, cut and paste, align, center, and reformat. Price: $295; upgrade for 2.0 users, $50.

Contact: Future Soft Engineering, Inc., 1001 South Dairy Ashford, Suite 203, Houston, TX 77077, (713) 496-9400.

Inquiry 1145.

Madge Introduces Bus-Mastering EISA for Token Ring

Madge Networks has entered the Extended Industry Standard Architecture arena with the Smart 16/4 EISA Ringnode. As the name implies, the card is designed for 802.5 token-ring networks.

The Smart 16/4 EISA Ringnode uses bus mastering capabilities to achieve internal electrical transfers at the maximum speed of the EISA bus—33 megabytes per second, the company claims. Smart Server software also helps you download NetBIOS and IPX/SPX onto each adapter's 128K bytes of RAM, which can free as much as 50K bytes of DOS memory, according to the company.

Price: $1495.

Contact: Madge Networks, Inc., 1580 Oakland Rd., Suite C-206, San Jose, CA 95131, (800) 876-2343 or (408) 441-1300.

Inquiry 1147.

Diagnostic ARCnet Hub Includes Net Management

The Ultra Hub serves up to eight ARCnet users with built-in diagnostic capabilities. It's available with transceivers for thick coaxial, twisted-pair, and optical fiber cabling.

For network management, the hub keeps a historical list of the 64 most recent reconfiguration events complete with time-stamp information, and it also maintains a connectivity map and has provisions for automatic disconnection/reconnection sequences. For example, Ultra Hub will automatically disconnect a problem-causing node, and when the problem has been resolved, it will automatically reconnect the node to the network.

The hub also protects the network from duplicate node IDs, one of the biggest problems with ARCnet LANs, Network Interface says. Rather than disconnect both nodes, the hub will automatically disconnect the duplicate ID that has created the problem.

Each hub supports redundant cable pairs for network security, and, of course, for redundancy. Hub software is included. Price: Coaxial, $725; twisted-pair, $895.

Contact: Network Interface Corp., 15019 West 95th St., Lenexa, KS 66215, (800) 343-2853 or (913) 894-2277.

Inquiry 1148.

Microcom Introduces MNP Class 10 on V.22bis Modem

Microcom says that its new QX/2400 modem with MNP 10 is the highest-performing V.22bis unit on the market. It uses the data compression of MNP 7 to achieve transmission speeds of up to 12,000 bps under optimal conditions, Microcom says, and with the added features of MNP 10, it can accommodate dirty telephone lines, signal fading, and other interruptions.

The latest in a series of Microcom Networking Protocols, MNP 10 works with the compression features of the widely used MNP5 and 7 standards, which provide double and triple the data rate through software.

Class 10 adds what Microcom calls ACE, or Adverse Channel Enhancements, which automatically change the transmission speed and packet size depending on the line quality. These improvements are especially useful, Microcom says, when signal clarity fades in and out, as in cellular links or for international transmission using outdated analog switching equipment. A feature of ACE called Robust Auto Reliable also provides backward compatibility with non-MNP modems.

Price: $699.

Contact: Microcom, Inc., 500 River Ridge Dr., Norwood, MA 02062, (800) 822-8224 or (617) 551-1000.

Inquiry 1146.
Take a look at the vast majority of graphical workstations developed over the past decade and you'll see something they all have in common:

An integrated UNIX® System environment.

Now take a look at the vast majority of businesses that have put computing power directly onto their office desktops over the past decade, and you'll see something they all have in common: Industry-standard personal computers.

It doesn't take a computer to forecast the platform that's going to put graphical workstations on the vast majority of business and engineering desktops in the next decade:

An integrated UNIX System environment for industry-standard personal computers.

And that's what Open Desktop™ is all about.

Open Desktop is the complete graphical operating system that's built on the most popular UNIX System platform of all time—SCO®. And it lets you create your own networked, icon-driven workstation environment using the industry-standard 386 or 486 computers and peripherals of your choice.

In a single, easy-to-use, fully supported—and completely integrated—package, Open Desktop delivers:

- the full 32-bit, multitasking computing power of SCO UNIX System V/386
- compliance with POSIX™ and X/Open® standards
- an OSF/Motif™-based, Presentation Manager-compatible, graphical user interface
- distributed SQL database management services
- compatibility with existing DOS, XENIX®, and UNIX System applications and data files
- NFS™, TCP/IP, and LAN Manager networking facilities

And all at an unbelievably affordable price.

Discover the complete graphical operating system that leading companies worldwide are choosing as their development platform for the '90s—and using to turn their 386 and 486 PCs into instant workstations today.

Open Desktop from SCO.
An All-in-One Communications Center

The Navigator is a telephone, an answering machine, a fax machine, and an XT-compatible computer. The system has separate circuits for the 8086 and the fax CPU, which let you use the phone and fax while running applications.

The computer has 640K bytes of RAM, dual 3½-inch 1.44-megabyte floppy disk drives, one parallel and one serial port, and a 10-inch monochrome EGA monitor that doubles as a pressure-sensitive control panel. This touchscreen lets you start applications by pressing the icon or symbol on the menu screen.

The unit’s built-in answering machine holds up to 12 incoming messages, which you can play back or delete from a remote phone.

The Group 3 fax machine lets you send a stored document from the disk by touching the screen. You can also send a document to as many as 100 different locations by using the sequential broadcasting capabilities of the system.

Price: $2995.

Voice, data, and video integration in the Navigator from Canon.

Contact: Canon U.S.A., Inc., Information Systems Division, One Canon Plaza, Lake Success, NY 11042, (516) 488-6700.

Inquiry 1151.

Make Your NuBus Mac a Multiuser Unix System

The DigiChannel Nu/Xi is an intelligent, multi-channel NuBus communication board that lets a Macintosh II running Apple’s A/UX Unix operating system act as a host computer for a multiuser environment. With eight boards, your Mac could support up to 64 channels.

Each DigiChannel Nu/Xi is equipped with a 12-MHz 68000 processor and 256K bytes of RAM. It offers either four or eight channels of synchronous or asynchronous communication, as well as four DMA channels. It also includes two to four serial controllers.

Price: Four-channel, $995; eight-channel, $1295.

Contact: DigiBoard, Inc., 6751 Oxford St., St. Louis Park, MN 55426, (800) 344-4273 or (612) 922-8055.

Inquiry 1150.

Hayes Upgrades the V-series with V.42bis

The V-series Ultra Smartmodem 9600 is a new 9600-bps V.32 modem from Hayes. It provides CCITT V.42bis for data throughput to 38,400 bps.

The Ultra 96 is backward compatible with V.22bis, V.22, V.21, and the Bell 103 and 212A standards. Features include V.42 Link Access Procedure for Modems (LAPM) for point-to-point error control, and V.42 Annex A for backward compatibility for modems with MNP 2–4. Support for Link Access Procedure Balanced (LAPB) provides error control for point-to-point or point-to-multipoint X.25 networks.

Also included is equipment for synchronous transmission and for leased-line communications, making the Ultra Smartmodem 9600 compatible with X.32, which is X.25 in dial-up.

Price: $1199; in Canada, $1699.

Contact: Hayes Microcomputer Products, Inc., P.O. Box 105203, Atlanta, GA 30348, (404) 441-1617.

Inquiry 1152.

Everex Joins Storage Dimensions for NetWare Server

Everex and Storage Dimensions have together developed a network server that eliminates the bus bottleneck.

The Everex Stepserver and Storage Dimensions LANStor FileMaster include a 33-MHz 80386 CPU with a modified (16.5-, 11-, or 8-MHz) AT bus, three-tiered caching, 32-bit networking adapters, and SCSI disk caching.

The resulting file servers have two to three times the data throughput of “PC-as-server” systems, the companies claim.

The base systems include a 150-megabyte SCSI hard disk drive, a 5¼-inch 1.2-megabyte floppy disk drive, 4 megabytes of RAM, a 128K-byte RAM cache, a 101-key keyboard, a Hercules driver, and a 12-inch monochrome monitor. The BIOS is a modified AMI design.

At maximum configuration, the systems sport 16 megabytes of RAM, an internal storage capacity of 1.3 gigabytes, and an external storage capacity of more than 18 gigabytes, thanks to the SCSI daisy chain and 1.2-gigabyte drives from Storage Dimensions.

In terms of caching, the 128K bytes of RAM cache is optimized for Novell’s disk-caching algorithm. In addition, there’s a scalable CPU cache of 256K bytes and a read-ahead caching scheme on the SCSI peripherals of at least one track (e.g., 64K bytes on a 38-megabyte hard disk drive).

Price: $11,599.

Contact: Everex Computer Systems Division, 48504 Kato Rd., Fremont, CA 94538, (800) 356-4283; Storage Dimensions, 2145 Hamilton Ave., San Jose, CA 95125, (408) 879-0300.

Inquiry 1149.
Now There Are Two Choices For OS/2 Databases:

Open Server

- Runs on every vendor's operating system:
  - OS/2, VINES*, UNIX*, VAX*, VMS, IBM* MVS, etc.
- Supports every vendor's local area network protocol:
  - Novell's* SPX/IPX®, NetBIOS, Named Pipes®, etc.
- Transparent access to data in other vendor's databases:
  - IBM's DB2® and SQL/DS, and Digital's RMS.
- Transparent data sharing between all your computers:
  - PCs, minis and mainframes.
- Your Lotus 1-2-3® spreadsheets and dBASE® applications work with ORACLE Server today.
- Developers have a complete and integrated family of portable tools for CASE, applications generation, report writing, etc.
- Programmers can use interfaces from C, COBOL, and FORTRAN.
- ORACLE Server is certified by Codd and Date to run at 11.0 TPI transactions per second.

Call 1-800-ORACLE, ext. 4965 today and order ORACLE Server for OS/2 for only $2499 and get six months of phone support and upgrades for free (a $500 value). Or try our Developer's Version (limited to 3 Users) for only $699.

Closed Server

- Runs only on OS/2.
- Supports only Named Pipes.
- Does not provide access to any other database.
- Can't even transparently share data between two PCs running Ashton-Tate SQL Server.
- Doesn't work with either Lotus 1-2-3 or dBASE just yet.
- Supports only Focus.
- Supports only C.
- Ashton-Tate SQL Server's published benchmarks show it to be slower.

ORACLE Server and Ashton-Tate SQL Server®

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Everything you always wanted to know about memory but didn't know how to ask.

There's Gold in Your PC!

And Here's the Map & Tools to Find It.
There’s Gold in Your PC!

And Here’re the Map & Tools to Find It.
When your PC programs were few and small in size, you didn’t have to think about memory as a precious resource to be rationed and used smartly. Today memory is just that! Pure Gold!

Today, each new program update brings a larger, more featured program. PC networks require software, resident in your PC, that communicates to the network. Easy-to-use, point and click, program interfaces require memory-resident mouse software. Terminate and stay resident (TSR) software, such as Sidekick, work best when they are on hand instantly.

What this means to PC users is that the 640K of memory used to run DOS programs is crammed full. So there’s much to be gained when you can use this memory more efficiently.

But, memory is important for another reason. It’s memory (and the right kind of memory) that enables DOS to be transformed into a next generation operating system. With the right kind of memory, you can run large (32MB or larger) programs. You can run several programs simultaneously (multi-task). And you can give your programs the space they need to communicate and work together (sharing data and starting new tasks).
Precious.

Those who understand how to get the most power out of a PC's memory have a significant advantage over those who don't. We know this—for Quarterdeck has been a leader in using memory to give DOS the power of OS/2.

1986—Quarterdeck's DESQview broke through the DOS 640 barrier—using expanded memory to multitask programs on 8088 and 80286 PCs.

1986—DESQview became an 80386 control program, providing multitasking for DOS using the 80386's extended memory.

1987—the Quarterdeck Expanded Memory Manager-386 (QEMM-386) transformed the 80386's extended memory into expanded memory.

1987—the Quarterdeck Expanded Memory Manager-50/60 (QEMM-50/60) transformed IBM's 80286 PS/2 Memory Expansion Option & Expanded Memory Adapter/A into expanded memory.

1987—in conjunction with Phar Lap Software specified the Virtual Control Program Interface (VCP), which ensured compatibility among DOS extended programs (such as Paradox 386, 1-2-3 Release 3), expanded memory managers, and control programs.
Introducing Your Treasure

Manifest is the map that can lead you to whatever gold is in your PC. It gives you an instant snapshot of your PC. And it tells you everything about your PC’s memory.

This includes an inventory listing of the hardware in your PC, details about your version of DOS, as well as a picture of the contents of your CONFIG.SYS and AUTOEXEC.BAT files. Manifest includes details on whatever memory you have (first megabyte, expanded, or extended) and even gives you hints on how you can better use it.

There’s lots you can do with Manifest. But for sure, keep Manifest on hand when you’re calling for support on a program or on your PC.

For the user new to a PC, Manifest is an introductory course, not only in memory, but in all the key components of a computer system—with the advantage that the information provided is about your own PC.

When you run Manifest, you’ll instantly learn whether your PC has the math coprocessor needed by AutoCAD, or the expanded memory recommended by 1-2-3 Release 2.

If you’re a power user, Manifest shows you the memory your PC hardware is addressing, and how interrupts are being used by both
Manifest
Map to the Gold.

hardware and software. And because Manifest can be run as a TSR, it becomes a debugging tool.

For the person responsible for supporting PCs in a company, Manifest gives an instant inventory of a PC—especially about memory and each device or program using this memory. Manifest gives you detailed information about the processor type (8088, 8086, 80286, 80386), DOS version, BIOS manufacturer and date, video adapters, serial and parallel ports, microchannel adapters, and much more—all without opening the case. This information can be printed or saved to a file on disk instantly. A real time savings!
You can use Manifest to display your CONFIG.SYS and AUTOEXEC.BAT files—very convenient when describing your PC.

Take Manifest along with you to the store. Manifest tells you what's under the hood of a PC. It even times your PC's memory and runs benchmark tests on expanded memory.
Manifest shows you whether you can use the memory from 640K to 1MB to run TSRs, network drivers, and DOS resources. It gives you maps of the first megabyte and information about the size and memory location of your TSRs. And it even makes recommendations on how to optimize the memory used on your system!
It's often not easy to assess how much gold is in any claim, but we've a product called QRAM (pronounced cram) to help. QRAM is a set of memory tools for 8088, 8086 and 80286 PCs that assist you in getting the maximum use of your PC's memory. QRAM can't work magic—but if you have memory capable of running programs but not currently being used, QRAM makes it available. To that end, QRAM manages your PC's high memory, EGA/VGA video memory, and extended memory.

High memory (the memory addresses between 640K & 1024K) has been traditionally reserved by IBM for use by PC hardware. As DOS programs have become larger, and as TSRs and networks have become more popular, high memory has increased in importance. The reason—there are often more memory addresses reserved for system hardware than are actually being used. So there are precious available memory addresses, waiting to be used!

If you have expanded memory hardware (compatible with either EMS 4 or EEMS expanded memory specifications), QRAM uses the expanded memory’s mapping capabilities to fill unused memory addresses in your PC’s high memory. Using QRAM, you can then load TSR's, device drivers (such as networks), and DOS resources (i.e. FILES or BUFFERS) in this memory.
an 8088 or 80286.

Depending on your PC, QRAM makes anywhere from 30-130K of high memory usable.

Note that QRAM can also load TSR’s, drivers and DOS resources high if your PC has shadow RAM.

You don’t have to be a PC guru to use high memory. QRAM, in conjunction with your expanded memory manager, automatically maps expanded memory into available addresses. Then QRAM’s optimize feature examines your CONFIG.SYS & AUTOEXEC.BAT files to determine what can be loaded high, and makes any changes necessary.

For those of you who need memory more than EGA or VGA graphics, QRAM makes the 96K reserved for your EGA or VGA adapter available to DOS programs. The caveat is that while you are using this memory, you can’t be doing graphics. But, QRAM makes it easy for you to turn on and off this feature.

That’s not all! QRAM is also an extended memory manager, compatible with the XMS extended memory specification, specified by Microsoft and used in Windows 286 v2.

The end result is that however you need to use memory, QRAM will do its best to make your memory into what you need.
A Gold Vein in

If you have an IBM PS/2 Model 50 or 60 with either an IBM 80286 Memory Expansion Option, an IBM Memory Expanded Memory Adapter/A, or compatible, there's a gold vein in those boards, ready to be mined.

Although you might not know it, built into these boards is the hardware necessary for expanded memory. You need only a special software driver to access that hardware! And that's what the Quarterdeck Expanded Memory Manager (QEMM-50/60) does. We have a new version, Version 5, which, in addition, takes advantage of high memory, EGA/VGA video memory, and extended memory.

QEMM-50/60 transforms any of the above boards into expanded memory, compatible with all three expanded memory specifications (EMS 3.2, EMS 4.0, EEMS). So there's no need to buy a special expanded memory board for a PS/2 Model 50 or 60. No worry. Just run your programs designed to take advantage of expanded memory (like 1-2-3 Release 2, Framework, Paradox 3).

QEMM-50/60, like QRAM, enables you to load TSR's, device drivers (such as networks), and DOS resources (i.e. FILES or BUFFERS) in high memory. And to assist you in determining what can be loaded high and where, QEMM-50/60 comes with its own microchannel adapter library.
PS/2 50’s and 60’s.

Even the novice PC user can set up QEMM-50/60 to get the best use of memory. For QEMM installs itself (and if you wish) has an optimize feature which can load your TSRs, network drivers and DOS resources in high memory—automatically.

For those of you who need memory more than EGA or VGA graphics, QEMM-50/60 makes the 96K reserved for your EGA or VGA adapter available to your DOS program. The caveat is that while you are using this memory, you can’t be doing graphics. But, QEMM-50/60 makes it easy for you to turn this feature on and off.

QEMM-50/60 is also an extended memory manager, compatible with the XMS extended memory specification, specified by Microsoft and used by Windows 286 v2.

If you use QEMM-50/60 with DESQview, DESQview can run (multitask) programs in expanded memory. However, in order to effectively use any DOS multitasking environment on a PS/2 Model 50 or 60 (DESQview, Microsoft Windows 2.0, or IBM 3270 Workstation Program), the PS/2’s motherboard memory must be disabled. You do need, then, at least 1.5 megabytes of memory on your IBM 80286 Memory Expansion Option before multitasking is effective.
QEMM-386: A Bonanza

You reap a memory bonanza with the Quarterdeck Expanded Memory Manager-386 (QEMM-386) Version 5. It's an expanded memory manager for 386 PCs and PS/2s.

And more. For QEMM-386 gives you maximum flexibility in memory usage. Like QRAM and QEMM-50/60, QEMM-386 lets you load TSR's, device drivers and DOS resources in high memory, manages EGA/VGA memory and acts as an extended memory manager.

In addition, QEMM-386 is also an 80386 control program. This enables QEMM-386 not only to take advantage of the 80386 processor to help you find more available high memory, but also to make 80386 power available to Quarterdeck's DESQview for multitasking, screen virtualization, and program protection.

QEMM-386 is compatible with all the current industry memory specification standards. EMS 3.2, EMS 4, and EEMS expanded memory specifications. The XMS specification for extended memory. And the Quarterdeck/Phar Lap virtual control program (VCPI) interface, (incorporated in 1-2-3 Release 3, IBM Interleaf, Paradox 386, and other powerful programs), for running protected mode programs in DOS.

It is QEMM-386's expanded memory capabilities that enables it to load TSR's,
In order to give you as much high memory as it can, QEMM-386 finds and maps memory addresses as small as 4K (rather than the 16K mapped by EMS managers).

Additionally, if your PC is either a Compaq configured with top memory or it has Chips & Technologies shadow RAM, QEMM-386 detects this memory and makes the best use it can out of it. For PS/2s and others using microchannel architecture, QEMM-386 includes an “Adapter Description Library” (ADL). QEMM-386 uses this information to insure a maximum amount of safely accessible high memory with PS/2s.

For users new to 386 PCs, QEMM-386 sets up your memory as optimally as it can—automatically. And it has an optimize feature which can load your programs high—so there’s no need to be a memory guru.

But, for memory addicts, QEMM-386 has two other features. The first, called Accessed, watches high memory and notes what has been accessed by your programs. The second, called Analyze, uses the information from Accessed to tell you what memory addresses you may additionally use to load TSRs, drivers, etc. The goal, of course, always, is to give you the maximum utilization of your most precious PC resource, memory.
DESQview & DESQview 386
Not to Be Ignored.


With DESQview you get the next generation computing capabilities now on your 8088, 8086, 80286, or 80386 PC or PS/2. And you get these powerful capabilities without obsoleting your investment in DOS, your programs, or your time spent in learning and using these programs.

For DESQview today multitasks within 640K and beyond. It does windows. It transfers data. It dials your phone. It gives you menus for DOS. It remembers your keystrokes (macros). And more.

When DESQview is combined with QEMM-386, it becomes an 80386 control program, taking advantage of its virtual 8086 machine architecture and its 32-bit protected mode. We call this combination, DESQview 386.

By controlling these 80386 features, DESQview 386 gives you program protection plus the ability to run large memory intensive 80386-specific programs side by side with your standard DOS programs. Moreover, DESQview 386 lets you run text or graphics (CGA, EGA, VGA, or Hercules) programs in small windows and in background.

NOTE: The 80386 processor's most powerful mode is its 32-bit protected mode. So that 32-bit 386 programs can run on DOS, a special program, called a DOS extender, must be part of the program. Realizing the importance of the DOS Extender, Quarterdeck has worked to ensure compatibility between DOS extenders (286 & 386) and DESQview. The result is the Quarterdeck Phar Lap Virtual Control Program Interface Specification (VCP), specifying the interfaces between DOS extenders and 386 control programs.
Yes! I'm interested in finding gold in my PC!

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<thead>
<tr>
<th>No. Diskette</th>
<th>Product</th>
<th>Price Each</th>
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<td>QEMM-386 (V5.0) (includes free Manifest!)</td>
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<td>DESQview 386 (V1.1) (DESQview, QEMM-386 and free Manifest!)</td>
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Shipping & Handling
- USA: $5.00
- Outside USA: $10.00

Sales Tax (CA residents): 6.5%

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Memory is gold.
And like gold, some of it is hidden away inside your computer. For years, we’ve been working toward putting it all under your control. And now we can.

Now you can make today’s more powerful programs run without giving up network and mouse drivers and TSRs.

Introducing Manifest—the Quarterdeck memory analyzer
Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest
Manifest shows you what’s ‘under the hood’ of your PC.

Manifest guides you deep inside your PC.
It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Introducing QRAM—the Quarterdeck memory optimizer
End RAM cram in your 8088, 8086, 80286 or 80386. If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V. 2.x.

If your PC has ‘shadow RAM,’ there’s even more gold in your PC. QRAM finds the unused parts and puts them under your control.

And if you have an EGA or VGA-equipped PC and don’t need graphics at the moment, QRAM will make an additional 96K ‘nugget’ of memory available! When you need graphics again, QRAM will switch you back to graphics mode! Think how helpful that will be for those big dBASE files.

QRAM can’t work miracles, but if there’s memory available anywhere, QRAM lets you use it to increase your PC’s speed and performance.

QRAM is available bundled with Manifest for just a few dollars more than Manifest alone.

Manifest and QRAM—two more examples of Quarterdeck’s commitment to mining the most productivity out of the PC and software you own today.
Introducing QEMM 50/60
Version 5.0

QEMM (Quarterdeck Expanded Memory Manager) 50/60 is the gold standard in memory management for the IBM PS/2 series 50 and 60. It works with IBM's Memory Expansion Option, Expanded Memory Adapter/A and compatible memory boards.

It supports all three specifications for expanded memory: EMS 4.0, EMS 3.2 and EEMS memory so you can run all expanded memory programs.

And it also works with Microsoft's XMS specification, in case you want to use Windows.

QEMM lets you use memory locations between 640K and 1024K to run TSRs, mouse and network drivers, DOS resources and MCA adaptors. That means you can gain up to 130K of memory space below 640K for your programs.

Best of all, QEMM is designed to be easy to use—even for those new to the PC. Just install it and type ‘optimize,’ and it looks at your AUTOEXEC.BAT and CONFIG.SYS files and loads whatever it can in high memory Automatically.

QEMM 50/60 is priced economically. It's the biggest boost you can give your PS/2 for under $100.

QEMM and DESQview let you multitask and window with the programs you know and use today.

Introducing QEMM 386
Version 5.0

QEMM 386 can expand the memory of all 386-based computers, including PCs with 80386 upgrade boards. It makes your memory compatible with EMS 4.0, EMS 3.2 and EEMS memory without having to add special hardware. It's compatible with protected-mode programs (like 1-2-3 Release 3, IBM Interleaf and Paradox 386) using DOS extenders compatible with the Quarterdeck/Pharlap VCPI spec.

QEMM also works with Microsoft's XMS spec to extend memory for Windows users.

QEMM gives you maximum control over your memory between 640K-1024K. It can find unused memory nuggets as small as 4K and use them to free up room for programs to use.

QEMM 386 even monitors how your programs use memory while they're running. Then it shows you where there's additional memory you can use. It even measures which parts of your memory are fastest and 'decides' how to use them for better performance. In action, it's easy and fun—almost like having an artificial intelligence program to help tune up your PC.

All these capabilities add up to greater performance at a very low cost. And QEMM lets you go for the gold without having to become an expert on the PC memory puzzle.

Like all Quarterdeck products, it works with your current PC and favorite software.

A few words about DESQview

What's the smartest thing to do with all that additional memory? Run DESQview and multitask your favorite programs in windows. Use a mouse or keyboard and you can run graphic and text-based programs side-by-side. All without having to invest in a bigger hard disk or more memory.

From Manifest to QRAM, QEMM and DESQview, Quarterdeck helps you mine the most from the software and PC you have today.
DOS and OS/2 Compiler for C++ 2.0

Zortech's C++ 2.0 Developer's Edition includes a compiler that complies with AT&T's C++ 2.0 specification, supporting object-oriented programming features such as multiple inheritance and type safe linkage. The compiler also supports the use of EMS in developed applications and includes a seamless edit/compile/debug environment that uses a Systems Application Architecture/Common User Access user interface.

In addition to the compiler, C++ 2.0 has full standard library source code, programming compatibility with Microsoft Windows, graphics classes, and a TSR library that lets most applications become resident with a single function call. The company has also released an OS/2 compiler upgrade.

Price: $450; OS/2 compiler upgrade, $149.95.
Contact: Zortech, Inc., 1165 Massachusetts Ave., Arlington, MA 02174, (617) 646-6703.
Inquiry 1154.

Dialogue Programming Tool for Windows

DialogCoder reduces the coding normally associated with dialog box programming, its developer reports. DialogCoder generates native C source code from a template you've created with a Microsoft or Whittier Group dialogue editor.

With DialogCoder, you can establish relationships among controls and specify the initialization state of each control. If your specifications are incomplete, DialogCoder will prompt you to fix the ambiguity or omission. You use DialogCoder's icons to establish control and action relationships. It supports listbox initialization from ASCII files, resources bound to an application, and directory lists. It also provides validation code for edit fields.

DialogCoder runs on the IBM AT with Windows 2.0 or higher.
Price: $499.
Contact: The Software Organization, Inc., P.O. Box 1926, Brookline, MA 02146, (800) 443-2864 or (617) 354-2012.
Inquiry 1157.

Normalize Databases for Unix Applications

With the Canonizer for Unix operating systems, you can reduce the amount of time it takes to normalize your database system, helping you to create a system with increased data integrity, improved query integrity, and simplified data organization. The design tool normalizes to the third normal form, its developer reports.

The Canonizer creates an ANSI-standard Structured Query Language script for use with Unix DBMSes such as Informix, Oracle, Ingres, Sybase, and others. It also provides a data dictionary for holding definitions of every item in the database.

One-to-one, one-to-many, and many-to-many relationships are supported. The Canonizer maintains multiple directories of database models and multiple databases within a directory. A view can maintain any number of data items and relations.

The Canonizer is compatible with SCO Xenix, System V Unix, SunOS, and BSD Unix.
Price: $1295; SQL converter, $295.
Contact: Six Sigma CASE, Suite 210, Bellevue, WA 98006, (800) 827-4462 or (206) 643-6911.
Inquiry 1163.

Two Ways to Develop CUA Interfaces

EasySAA is an application generator for developing cooperative processing interfaces in DOS that are upwardly compatible with OS/2 while complying with IBM's Systems Application Architecture/Common User Access. You can use EasySAA to develop front-end interfaces to 3270 mainframe applications, allowing the intelligence of the PC to share responsibility with a mainframe in a communications task.

With EasySAA, you can develop peer-to-peer applications and mixed 3270 and peer-to-peer applications. The generator combines editing, compiling, debugging, and testing in one environment. It can automatically produce prototype applications with color, menu placement, help, and keyboard handling. Language templates assure consistency at large sites.

EasySAA has a code library and is object-based. Objects supported include procedures, windows, dialog boxes, list boxes, help files, and libraries. EasySAA requires Infront or Infront/HPO, Multi Soft's development system, and an IBM PC with 640K bytes of RAM.
Price: EasySAA, $500; Infront, $1500.
Inquiry 1155.

The cooperative processing package Mozart now includes a Librarian that lets you distribute PC files to remote workstations, Aspen Research reports. Changes made at the workstation are stored in a host library. In addition to interface updates, the Librarian can distribute data files and other applications directly through screens using a proprietary data compression and conversion technique.

Mozart lets you modernize host applications at the front end, allowing you to make them SAA/CUA-compliant without moving to OS/2 or rewriting application code. It supports IBM 8/370, AS/400, System 36/38, Hewlett-Packard, Digital Equipment, and Prime computers. An application can have up to 64,000 panels, Aspen says. Mozart includes a dBASE IIIPlus database management facility for validating files at the PC level.

Mozart runs on an IBM PC and consumes about 300K bytes of memory. It is upwardly compatible with OS/2, and an OS/2 version is scheduled to ship late in the first quarter.
Price: $1295; run-time modules, $195 to $495; Librarian, $7995.
Inquiry 1156.
CONTROL & DATA ACQUISITION

Enter the picture... the BayTech H-Series Multiport Controllers—stand-alone multiplexers that connect one host computer to as many as 23 peripheral devices. By cascading, the number of devices you can connect is practically unlimited. Full duplex transmission of asynchronous data is provided at speeds up to 38,400 bps. These intelligent multiports will operate with any RS-232C serial computer or peripheral device. (Optional RS-422A).

The H-Series models have been used extensively in each of these areas:

- security and environmental sensing, to improve monitoring capabilities for large and small businesses
- medical data monitoring environments, where speedy responses are vital and critical information must reach the host computer immediately

Control

Courtesy Siemens Life Support Systems.

Process Control

Courtesy Ford Motor Company.

- data exchange among point-of-sale devices, through which a myriad of business equipment can be operated from one computer

Point of Sale

Courtesy Hugin Sweda.

Six Modes of Multiplexing

To meet individual needs, these flexible, multifunctional devices are easily tailored by selecting one of six modes of multiplexing: time-division, port expansion/sharing, and four modes of buffered message multiplexing. In a typical application, the host port may be connected to a computer and the peripheral ports may be connected to such devices as bar code readers, cash registers, fire alarms, numerical machines, modems, plotters, printers, security systems, and terminals (see illus.).

BayTech offers unlimited hotline technical support before and after you purchase a unit. Designed and manufactured in the USA, the reliable H-Series is UL- and CSA-listed and fully covered by a one-year warranty.

So put yourself into the picture... call us today to learn about the many ways the H-Series Multiplexer-Controllers can benefit your business.
VP-Planner in 3-D

Paperback Software says that the new version of its VP-Planner spreadsheet offers most of the advantages of Lotus 1-2-3 release 3.0, including three-dimensional worksheets, while running in as little as 384K bytes of RAM.

The three-dimensional feature lets you work with a stack of worksheets where the worksheets form a cube of information that you can view or rotate. Formulas on any page can include cell references to different pages.

Other improvements include hot links among graphs, worksheet data, and worksheet files on disk and in memory. In hot linking, a change made to a graph is automatically reflected in a dependent worksheet, and vice versa. Paperback Software also promises LAN compatibility, with file locking, and support for up to 32 megabytes of expanded or virtual memory.

VP-Planner is keystroke-, file-, and macro-compatible with 1-2-3 release 2.2 and lower, the company reports.

Price: $295.
Contact: Paperback Software, 2830 Ninth St., Berkeley, CA 94710, (415) 644-2116.

Inquiry 1168.

Two for Uncle Sam

TurboTax can help you prepare your Personal/1040 tax return and plan for the rest of the year.

You start by answering a series of questions that help determine the tax form you'll need to use. IRS instructions that are keyed to each line of the tax form are available online, and the program is shipped with the Price Waterhouse Personal Tax Advisor.

TurboTax includes pop-up notes that you can use to post reminders. The program can link to 41 state versions of the program, so that when you prepare your federal return, you're also working on your state return.

Available schedules include D1, a second copy of F, Schedule 2 (Form 1040A), and Forms 4952, 8283, 8808, and 8814. The program can handle up to four what-if scenarios.

TurboTax works on the IBM PC with DOS 2.0 or higher and 384K bytes of RAM. With DOS 3.2 or higher, you need 512K bytes of RAM.

Price: $75; state versions, $40 each.
Contact: ChipSoft, 5045 Shoreham Place, San Diego, CA 92122, (619) 453-8722.

Inquiry 1169.

By using the 1989 edition of MacInTax or MacInTax for Windows, you can file your taxes electronically and receive a refund in as little as three days, SoftView reports.

The company has joined forces with a nationwide electronic filing service to provide for electronic filing. To receive a refund within three days, you pay a $39.95 filing fee. To receive a refund in the normal amount of time, you pay $29.95 to file electronically.

MacInTax for Windows and MacInTax can display Form 1040 and more than 75 other federal tax forms, schedules, worksheets, and statements, plus eight state tax supplements, on-screen. You can then print an exact replica of the form, complete with data, the company reports.

MacInTax requires a Mac 512KE or higher. For the Windows version, you'll need an IBM AT with 640K bytes of RAM. A version for professionals, called Taxview, is also available in Windows and Mac versions. It consists of a series of individual modules—1040, 1065 (partnerships), 1120 (corporations), and 1120-S (S-corporations)—plus state supplements, electronic filing, and a multyear tax modeling program.

Price: $99. Taxview: Electronic Filing, $149; Planner, $295; 1040, $495; 1065, $1120, and 1120-S, $395 each; state supplements, $79 each.
Contact: Softview, Inc., 1721 Pacific Ave., Suite 100, Oxnard, CA 93033, (805) 385-5000.

Inquiry 1170.

continued

Interface Makes DOS a Breeze

A new version of SoftBreeze, the user interface that offers you task switching, an applications menu, and file, disk, and memory management for plain old DOS, provides a Systems Application Architecture-compatible menu structure while letting you view and launch applications from data files.

According to SoftShell, SoftBreeze makes DOS easier to use and more powerful, but not in the restrictive and limited ways of DOS shells.

SoftBreeze 3.0's menu lets you choose among applications, task switching, the file manager, disk utilities, memory management, and customizing. As with BrightBill-Roberts' HyperPAD, system administrators can customize an individual's user interface.

SoftBreeze is a character-based application with a tree-style file manager. The document manager lets you link each file to its application program. Each file name can be up to 60 characters long in the new version. You can search for filenames by name, by part of name, or by who created it. The program's proprietary programming language, called Nautilus, lets you use disk swapping to create virtual memory, and you can toggle among the four management modules and up to 10 applications.

You can also use the program to copy data from one application to another. If you're not sure of an application's DOS name, you can press the Enter key and jump into a tree diagram, where you just point and click at what you want to copy. More than 100 common programs are automatically incorporated into the menus if SoftBreeze finds them on the disk when it's installed.

SoftBreeze runs on the IBM PC with 512K bytes of RAM and DOS 3.0 or higher. For task switching, the program needs 640K bytes of RAM. When running the program's Switch module, it requires an additional 19K bytes of RAM.

Price: $99.
Contact: SoftShell Systems, 1163 Triton Dr., Foster City, CA 94404, (415) 571-9000.

Inquiry 1167.
Introducing AccuCard™.
The only UPS that fits in your hand. And into your computer.

Remember when UPS systems were bulky, expensive outsiders? No longer.
AccuCard™ is the first UPS that fits right in your XT or AT expansion slot. It takes up only half a slot next to the power supply. No space at all on your desk. And very little budget.

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When the power comes back, built-in AccuSaver™ software will even automatically re-load your PC back to precisely where it was. All system status, registers, buffers, memory, and data intact. Just as if nothing had happened.

The remarkable new AccuCard lists for only $249. Yet it can save your MS-DOS based PC data even when it’s unattended. This may be the best insurance value you’ve ever seen.
AccuCard comes from the world’s leading UPS supplier and is available through distributors and dealers near you. Just call 1-800-Back-UPS.

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Available through your local Distributor: Pioneer Technologies Group (800) 227-1690, Avnet Computer Technologies (800) 877-2226, RMA Microtech (314) 726-0195.

Circle 97 on Reader Service Card (DEALERS: 98)
Smalltalk/V® PM.

Think of it as a bold, “seat-of-the-pants” solution that cuts to the heart of the OS/2 Presentation Manager complexity challenge. Thus unlocking the potential of this powerful operating system.

With the introduction of Smalltalk/V PM, object-oriented programming moves out of the realm of mystery and into a new era of breakthrough applications that promises to be of legendary proportions.

OS/2 PM is designed to push “user friendly” to a whole new level of sophistication. If you compare it to an orchestra, OS/2 has capabilities no ordinary assemblage of instruments has ever dreamed of possessing. Yet to tap its potential, OS/2 PM demands a conductor capable of true genius. That conductor is Smalltalk/V PM.

You’ll find Smalltalk/V PM a perfect language for representing and manipulating high-level information. Because you go from designing to prototyping to delivering a completed application in one seamless step, you cleanly avoid the old costly “crash and burn” delays so common with languages born in the age of mainframes.

UNLEASHING THE AWESOME POWER OF OS/2 PM

Smalltalk/V PM. It helps stop the natural drift toward vaporware so common in software development today. It lets you dive right in and get to the creative parts without the usual grunt work. For example, if you want to ignore the complexities of understanding OS/2 PM details you can immedi-
fast, seat-of-the-pants way

THE FIRST FULLY-COMPiled SMALLTALK. Because Smalltalk/V PM is fully compiled it provides you with a more responsive environment than ever before. Now you'll be able to generate stand-alone applications (.EXE).

debugger simplifies application development and gives you instant response when you implement an idea. Our extensive user manuals and tutorials have earned us high praise.

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"Digital''s Smalltalk/V PM is a masterful implementation of a classical object-oriented programming language and a state of the art graphical user interface. Any programmer struggling with the complexities of Presentation Manager should take a close look at this product."

Charles Petzold, Contributing Editor, PC Magazine

"Digital's Smalltalk/V PM is dazzling! This product makes Presentation Manager pay off."

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1-213-645-1082

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WHAT'S NEW

CAD AND GRAPHICS

Drafrix Windows CAD can enlarge a portion of a deck plan,
eliminating the need to repeatedly zoom in and out of a view.

CAD for Microsoft Windows

Drafrix Windows CAD, a Microsoft Windows application,
lets you divide your screen into four independent views,
each of which can show a portion of a drawing at a different ratio.
Windows can be actively linked, so that when you make a change in
one, it is reflected in the others. The program has a
programming language, called Drafrix Graphic Language,
that offers extensions for interfacing with the program's
database, function definitions, and menu modification.
Drafrix Windows CAD's attribute system lets you annotate images with text or numeric values.
You can tag up to
60 attributes to a symbol, line, or arc, allowing for the easy creation of job estimates
or invoices. The program's icon display lets you view a picture of a symbol instead of
requiring you to remember an obscure filename.
Drafrix Windows CAD supports associative dimensioning facilities, which
means that if you change an entity, all dimensions linked to the entity are automatically redrawn. It also includes a
library of more than 400 symbols. Optional symbol libraries are available.
Price: $695; symbol libraries, $150 each.

Contact: Foresight Resources Corp., 10725 Ambassador Dr., Kansas City, MO 64153, (816) 891-1040.
Inquiry 1173.

Photorealism with CADKey

CADKey Render employs Pixar's Render
Man technology to let you produce photorealistic color
images of three-dimensional geometric models by using
CADKey 3. Once you've drawn a project using CADKey 3,
use CADKey Solids to prepare the drawing. With CADKey Render, you can place light sources
and assign attributes (such as reflectivity or the appearance of wood) to a surface,
and the program will produce the image.
Price: Unix version, $5995; DOS version, $5595.

Contact: CADKey, Inc.,
440 Oakland St., Manchester, CT 06040, (203) 647-0220.
Inquiry 1175.
WHETHER REPORT.

Whether you're a software developer writing new applications for the IBM or Mac, or a PC user securing proprietary data files, software and data protection has never had a brighter silver lining. For a number of very good reasons.

Beginning with the 'whether-expert' Rainbow Technologies. And ending with its Software Sentinel family of hardware keys. Starring five models that fit virtually any software program or data file you need to protect.

There's the best-selling SentinelPro for the IBM PC/XT/AT, PS/2 and compatibles, and even the Atari ST. Known worldwide for its virtually unbreakable security. And its ASIC technology. And its invisible operation. A close relation, the Sentinel-C stands at-the-ready for custom configurations and multiple software packages.

In the Apple market, security-minded Mac software developers turn to Eve. For completely transparent operation and world-class security of the protected software. Just by plugging Eve into the Mac ADB connector.

PC users wanting a low cost, user-friendly solution to the problem of securing sensitive data can call on the DataSentry. Using a proprietary Rainbow algorithm or DES, the DataSentry encrypts data files on individual PCs, protects modem transmissions and secures data on local area networks.

Rainbow's latest protection strategy is the SentinelShell—that lets users place a 'shell' around existing, off-the-shelf programs. Because access can be limited to those issued a key, libraries, universities and corporations can very simply guard their software investments.

Whatever your whether, Rainbow Technologies has the software and data protection products that make the difference. For more information, call 714-261-0228 in the U.S., or contact Rainbow Technologies Ltd. in the United Kingdom for the distributor nearest you. Whethercasters are standing by.

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Circle 225 on Reader Service Card (DEALERS: 226)
HASP ™ - Hardware for Software Protection

As a software producer, you can't market your software without protecting it. Aladdin Knowledge Systems is a leading company in the field of software protection; during the last four years we have enabled hundreds of software producers in more than 30 countries to protect their software.

HASP 3™ connects to the parallel port of PC/XT/AT and PS/2 computers and compatibles. HASP-3's advanced technology prevents reverse engineering, making the plug virtually un-crackable.

HASP-3 FEATURES:
- Access Password - A unique password supplied
- to the software developer is needed in order
- to access the plug's code.
- The Highest Compatibility and transparency.
- Full Software Support.
- Automatic Virus Detection option.
- Daisy-chain of several plugs.

MemoHASP ™ is the last word in software protection. In addition to all of HASP-3's advantages, MEMOHASP contains 112 or 496 bytes of read/write memory. Programming the memory is done on the PC without any special programming equipment!
- There is no Battery in the Plugs!

HASP-3’s advanced technology prevents reverse engineering, making the plug virtually un-crackable.

HASP-TP ™ is an advanced technology plug that supports multiple software applications. It contains 112 bytes of read/write memory and is compatible with all versions of Microsoft Windows 3.x.

Circle 17 on Reader Service Card (DEALERS: 18)

Software Protection

Quark®/PC

HASP-3 ™ carries a software protection system that prevents reverse engineering, making the plug virtually un-crackable.

HASP-3 ™ features include:
- Access Password
- The Highest Compatibility and transparency
- Full Software Support
- Automatic Virus Detection option
- Daisy-chain of several plugs

HASP-TP ™ is an advanced technology plug that supports multiple software applications. It contains 112 bytes of read/write memory and is compatible with all versions of Microsoft Windows 3.x.

ALADDIN KNOWLEDGE SYSTEMS

Circle 18 on Reader Service Card (DEALERS: 18)

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WHAT'S NEW

CAD AND GRAPHICS

Civil Engineering and Architecture on the Mac

DCA Engineering has released two add-ins for AutoCAD for the Macintosh. Auto-Architect includes tools for design, three-dimensional planning, elevation, and input and editing in plan. Three options are available for plumbing, HVAC (heating, ventilation, and air conditioning), and electric.

Mac-Civil provides coordinate geometry, topographic, and civil engineering design applications.


Contact: DCA Engineering Software, Inc., P.O. Box 955, Henniker, NH 03242, (603) 428-3199.

Inquiry 1178.

Four Types of Drawing in One Package

UltraPaint lets you do black-and-white and color painting, gray-scale image processing, and object drawing. It supports 256 colors, blended fills, a multicolor airbrush, masking, and other special effects. UltraPaint also supports Bezier curves, scaling, 600-dpi precision, eight layers, and auto-tracing of bitmap images.

You can use only the black-and-white capabilities of UltraPaint on a Mac Plus and later migrate to a Mac II.

Price: $199.

Contact: Deneba Software, 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.

Inquiry 1176.

Convert PostScript into Editable Mac Fonts

Metamorphosis can convert printer-resident PostScript fonts into editable outline formats that you can use in a drawing program on the Mac. The utility grabs the font outline from the printer and brings it into the Mac. During the process, you can create an editable font for use in Aldus FreeHand, Adobe Illustrator, or Altsys's Fontgrapher, a PostScript font design program that creates Type 3 PostScript fonts that you can use in your Mac application.

Metamorphosis runs on the Mac Plus or higher.

Price: $295.

Contact: Altsys Corp., 720 Avenue F, Suite 109, Plano, TX 75074, (214) 424-4888.

Inquiry 1176.

Continued
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Soon after it was introduced in 1980, this math co-processor became famous for speeding things up. In 286 PCs and workstations it made spreadsheets calculate noticeably faster. In CAD/CAM environments it delivered screen redraws in a fraction of the time. And it made scientific, engineering and graphics programs zoom along like never before.

In fact, for any application involving intensive floating-point arithmetic calculations, speed and productivity were dramatically improved.

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**EasyPlot’s interactive math feature lets you plot an equation, transform data with a complex function, and compare the two.**

**Plotting Software for the Daily Grind**

EasyPlot combines a graphical interface with technical plotting capabilities in a package that’s intended for everyday use in the lab. According to Spiral Software, EasyPlot’s intuitive interface makes computing a complex fast Fourier transform as simple as a basic adjustment of the range of an axis.

With EasyPlot, you present the data, and it plots it for you. It can accept ASCII, .WK!, and .WR! data files and automatically plot them with easy-to-understand tick marks and axis ranges. You can select from linear, log-log, contour, and other popular graph types. The program lets you interact with the data by zooming in and out of a graph, scrolling, and placing the cross-hair view on a data point to view its coordinate.

EasyPlot also lets you transform data with any mathematical equation that you specify. It will plot the new graph in a different format for comparison.

The program runs on the IBM PC with 400K bytes of RAM.

Price: $269.

Contact: Spiral Software, 6 Perry St., Suite 2, Brookline, MA 02146, (800) 833-1511 or (617) 739-1511.

Inquiry 1027.

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**PCB Design Package for OS/2**

Microtel Pacific Research has released what it says is the first set of printed circuit board design tools that run under OS/2.

Called Ledax Plus, the program includes XScheme (schematic capture), XBoard (two-dimensional documentation/drafting), XPlace (automatic/interactive file routing), and XPost (artwork/plotting postprocessors). Each is linked to the others through a single database, with changes in one tool immediately reflected in the others. The company says that active linking reduces data entry, errors, time, and cost.

Microtel says that the program fully supports OS/2’s multitasking capabilities and the Presentation Manager graphical interface.

Price: $8795.

Contact: Microtel Pacific Research Limited, 8999 Nelson Way, Burnaby, BC, Canada V5A 4B5, (800) 663-6226 or (604) 294-1471.

Inquiry 1028.

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**WHAT'S NEW**

**SCIENCE AND ENGINEERING**

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### WHAT'S NEW

#### Mechanical Engineering by Dimension

A mechanical engineering program for Microsoft Windows, called Analytix, uses a geometry system that lets you perform kinematic, static, dynamic, and tolerance analysis without entering formulas or using a spreadsheet. Saltire Software says that the system, called constructive variational geometry (CVG), offers the advantages of speed, accuracy, stability, and simplicity over the conventional approach of using numerical analysis techniques.

Saltire’s program, Analytix, uses constructive geometry to reduce a geometric figure to a sequence of constructions. Once you’ve dimensioned a sketch, you can solve kinematics and statics problems analytically instead of converting the geometry problem to an algebraic problem.

The algebraic approach can be flawed in that the algebraic problem may not coincide exactly with the geometry problem. In some cases, the problem can yield multiple solutions, or none at all, when solved algebraically. Analytix chooses the solution that is closest geometrically to the sketch. Saltire says that when doing tolerance analysis, one advantage of using CVG over the Monte Carlo technique is that you get true maximum/minimum tolerances.

Analytix runs on the IBM AT with 640K bytes of RAM and a hard disk drive.

**Price:** $895.

**Contact:** Saltire Software, P.O. Box 1565, Beaverton, OR 97075, (503) 642-1874.

Inquiry 1029.

---

#### Make Waves on the Mac

SuperScope is a waveform acquisition, analysis, presentation, and data management program that works in conjunction with GW Instruments’ MacAdios family of add-in boards for the Mac SE and II. The software provides a real-time oscilloscope, an XY recorder, a strip chart recorder, and spectrum analyzer capabilities. It can acquire eight waveforms simultaneously and display up to 50. SuperScope includes an internal spreadsheet-like environment and a text editor.

The program lets you control all instruments and sensors from the Mac. Using the program’s analysis and graphing capabilities, you can create your own instruments. Analysis features let you manipulate your data with both arithmetic and transcendental functions. Included are trigonometric and logarithmic operations and statistical analysis like averaging, minimum/maximum locations, and standard deviations. In addition, digital signal processing functions are included. You can store and display the results of all analyses in graphical or tabular form.

Postprocessing modules support such tasks as pulse analysis, IEEE-488 data manipulation, data transfer, delay processing, drivers, digitizers, timing, function generators, and time stamping.

**Price:** $990.

**Contact:** GW Instruments, Inc., 35 Medford St., Somerville, MA 02143, (617) 625-4096.

Inquiry 1030.

---

### VP-Planner® 3D

The Spreadsheet with more power, more features, and better performance...at the best price!

<table>
<thead>
<tr>
<th>Feature</th>
<th>VP-Planner 3D</th>
<th>1-2-3® Rel 3.0</th>
<th>1-2-3® Rel 2.2</th>
<th>Quattro Pro®</th>
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**Regional**

**What's New**

**Midwest**

Controversy in Reorganization of APCUG

The fourth annual Users Group Summit held in Las Vegas began amid reports of growth and the formation of an incorporated nonprofit organization. The summit ended with mild controversy over the selection of officers and concern over the future of the organization.

Jerry Schneider, executive director of the Association of PC Users Groups (APCUG) until the group reorganized, began the meeting by noting that the association included 117 member groups, from the U.S., Canada, Japan, Australia, and the Soviet Union.

Schneider then introduced the new officers and board of directors of the volunteer organization, which is designed to bring vendors and manufacturers together with the hundreds of users groups around the world. Schneider also announced a new structure of APCUG, which also includes a 15-member users group advisory board. Three of the new directors, Don Kaufer of Salt Lake City, Cathy Konas of Chicago, and Scott Young of Minneapolis, hail from the Midwest.

The officers and board members will not represent any specific users group, instead holding their allegiance to APCUG, according to Schneider. The users group advisory board will be made up of people elected by designated delegates from member users groups. The advisory group will help the directors set policy and provide direction.

Some delegates to the Users Group Summit expressed concern about their inability to vote for the directors and the direction in which APCUG seemed to be heading.

Despite some lively discussion, the general consensus of the group was to give the new officers a year to show what they can accomplish. Named as the first official officers were: President: Roland J. Cole, a former officer of the Pacific Northwest IBM Users Group; Secretary: Jerry Schneider, executive director until incorporation; Treasurer: Larry Shaw, from Seattle and a founding member of the Pacific Northwest group.

Schneider also announced that the new board has set annual dues for member users groups at $25, starting with the 1990 calendar year. Previous dues collected from noncharter member groups will be refunded as part of the reorganization.

—Reported by David Reed of the Central Kentucky Users Group.

Contact: Association of PC Users Groups, 1101 Connecticut Ave. NW, Suite 901, Washington, DC 20036.

**Yellow Pages**

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Electric Bookshelf reports it now has versions of the PC Yellow Pages for several major metropolitan areas.

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markets, including Chicago. PC Yellow Pages includes name, address, ZIP +4 code, and carrier route code for each listed business, making it helpful for direct marketing.

When you prepare a mass mailing, the program tells you whether a mailing list or portion of it qualifies for a carrier route. You can search the database for a certain business type and add, change, or delete entries. You can make up to one page of comments per entry. Each city version includes sales lead management software for tracking sales leads and quotations.

Monthly updates are provided, or you can download them with AT&T's 900 telephone service. The program requires 512K bytes of RAM on an IBM PC. A hard drive is recommended.

Price: Atlanta, $165; Boston, $195; Chicago, $175; Dallas/Fort Worth, $175; Los Angeles, $275; Miami, $195; New York City, $395. Other areas are available for $129 per 5000 names and addresses.

Contact: Electric Bookshelf, Inc., 3066 Mercer University Dr., Atlanta, GA 30341, (404) 455-8763 or (404) 448-6881.

Inquiry 1002.

Computer Show in Ohio

The Mansfield Midwinter Hamfest/Computer Show will be held on Sunday, February 11, at the Richland County Fairgrounds in Mansfield, Ohio.

Contact: Dean Wrasse, 1094 Beal Rd., Mansfield, OH 44905, (419) 589-2415 after 4:00 p.m. EST.

Colorado Group Merges with LAN Group

The Front Range PC Users Group recently merged with a local chapter of the Rocky Mountain Local Area Network Users Group. The LAN group will be structured as another Front Range special-interest group. Almost all the members of the SIG are corporate or governmental, but anyone can join the group, FRPCUG reports.

Front Range general meetings are usually held the first Tuesday of every month.

Contact: Front Range LAN/SIG, 305 Magnolia, Suite 152, Fort Collins, CO 80521, (303) 482-3413 or (303) 484-1352.

SoftwareFest Sponsored by St. Louis Group

The St. Louis Users Group for the IBM PC reports that it will be holding its third annual SoftwareFest on March 24.

The 600-member users group meets the first Thursday of every month at Simon Hall on the Washington University campus.

Contact: St. Louis Users Group for the IBM PC, P.O. Box 69099, St. Louis, MO 63169, (314) 968-0992.

The St. Louis Area Network Users Group has merged with a local chapter of the Rocky Mountain Local Area Network Users Group.

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Skyworld Upgrades Fax Software

SkyFAX 2.0 software works with the SkyFAX Intelligent PC-Fax Board. The software includes a print-to-fax feature that sends the output file of any IBM PC application to a remote fax station, according to Skyworld Technology. Database broadcast is a feature that lets you merge data from dBASE III Plus records into a fax and broadcast the documents according to fax numbers contained in the database.

The SkyFAX board conforms to CCITT Group 3 standards and communicates at 9600 bps and lower.

Price: Software and board, $399.
Contact: Skyworld Technology, 1772 Lark Lane, Sunnyvale, CA 94087, (408) 446-9392.
Inquiry 1003.

DOS Extender Loads FCBs, IFSes into High Memory

The newest version of Advanced Memory Specification (AMS), RYBS Electronics’ DOS extender, lets you load buffers, stacks, device drivers, the network shell, and TSR programs into high memory. It also lets you load DOS 4.01 file-control blocks, stacks, and installation file systems into high memory above 640K bytes, the company reports.

RYBS says that AMS supports almost any device. The program also supports extended and expanded memory.

Price: Software-only version, $99.95.
Contact: RYBS Electronics, Inc., 2590 Central Ave., Boulder, CO 80301, (303) 444-6073.
Inquiry 1005.

Write Compact TSR Programs with CodeRunner

The CodeRunner library lets you write TSR programs in C that have the compactness and performance of programs written in assembly language, Microsystems Software reports. When the TSR program becomes resident, its initialization code and data are eliminated, allowing for elegant sign-on screens, comprehensive command-line parsing, and other initialization tasks without burdening resident-memory overhead, the company reports.

With CodeRunner, you can write multitasking TSR programs where a timer, communications port, keyboard, or any other hardware or software interrupt can trigger multiple threads. CodeRunner automatically handles all stack and entry protection.

CodeRunner includes a binary-coded-decimal floating-point package with variable precision from 8 to 248 significant digits. You can specify up to 256 hot keys for any application. The runtime library is function-level granular and auto-initializing, which helps save program memory overhead.

Because CodeRunner allows transparent DOS access for your program, you can call up the application regardless of DOS’s state, according to the company.

CodeRunner is written in assembly language and works with Borland’s Turbo C and Microsoft C.
Price: $149.
Inquiry 1004.

Draw Chemical Structures in Four Environments

With Molecular Presentation Graphics for OS/2, Hawk Scientific Systems now supports four platforms on which you can draw chemical structures. In addition to Presentation Manager, the company supports versions of MPG for DOS, Microsoft Windows, and the Macintosh.

MPG supports rings, alkyl chains, bonds, Greek text, and display text. You can annotate reactions with arrows and add titles and captions. The Windows and DOS versions can export images in WordPerfect, PIC, Encapsulated PostScript, CGM, and Hewlett-Packard Graphics Language format. On the Mac, you can export images through the Clipboard. You can also import HPGL and Tektronix 4010 images.

MPG for OS/2 requires about 300K bytes of system memory. The DOS version runs on the IBM PC with 512K bytes of RAM. The Windows version runs on the IBM PC AT with 640K bytes of RAM. On the Mac, you'll need a Plus or higher.

Price: OS/2 version, $350; other versions, $275.
Inquiry 1006.

ChemWindow lets you draw chemical structures under Microsoft Windows. Using Windows’ ability to switch among applications in several windows, you can draw the structure without leaving the word processor and then pull it into the document with the Windows clipboard.

Tools in ChemWindow let you place symbol strings and 10 types of bonds. Five arrow types include reaction, equilibrium, resonance, dashed, and retrosynthetic. You can draw solid or dashed circles, ovals, and arcs. ChemWindow has an undo facility, and you can use the program to scale objects.

To run ChemWindow, you need an IBM PC with 512K bytes of RAM, a mouse, a graphics adapter, and a hard disk drive. A run-time version of Windows is included with the program.
Price: $295.
Contact: SoftShell International Ltd., 2754 Compass Dr., Suite 375, Grand Junction, CO 81506, (303) 242-7502.
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Nanao Monitors for the Mac or IBM PC

The FlexScan 6300 displays two pages side by side in resolutions of up to 1664 by 1200 pixels on the IBM PC and up to 1024 by 768 pixels on the Mac II. The 6300 adjusts for horizontal scanning frequencies of between 31.5 and 78 kHz and vertical scanning frequencies of between 60 and 80 Hz. It substitutes a palette of more than 64,000 shades of gray for the colors supported by VGA and Extended VGA.

The FlexScan 9400 is a 20-inch multiscanning color monitor that displays resolutions of up to 1280 by 1024 pixels. It offers a palette of 16.7 million colors and resolutions of up to 1024 by 768 pixels on the Mac II, when used with graphics boards like the SuperMac Spectrum/24 or Spectrum/32 or the RasterOps ColorBoard 108. The 9400 features a standard nine-pin connector for standard TTL and analog signal input and BNC connectors for high-frequency analog input.

The FlexScan 9060S is a 14-inch high-resolution multiscanning monitor. It has a horizontal scanning range of 15.5 to 38.5 kHz and a vertical range from 50 to 90 Hz. It displays in resolutions of up to 800 by 600 pixels noninterlaced on the IBM PC and compatibles and in resolutions of up to 640 by 480 pixels on the Mac II.


Contact: Nanao USA Corp., 23510 Telo Ave., Suite 5, Torrance, CA 90505, (213) 325-5202.

Inquiry 1009.

Multitasking, Multitasking Operating System

PC-MOS 4.0 is an operating system that supplants DOS and lets you run most DOS applications in a multiuser, multitasking environment. With version 4.0, you can reboot a task without interrupting other users, The Software Link reports. Other additions include new driver software that lets PC-MOS support full-color, bit-mapped graphics with resolutions up to VGA, allowing up to 16 workstations with graphics to tag onto a single CPU, the company reports.

A new print spooler lets a single print processor control the output to multiple printers simultaneously. With the included monitor program utility, a system administrator controls various aspects of a task, including priority and time allocation. PC-MOS 4.0 can relocate into extended memory and requires about 128K bytes of RAM. It supplants DOS 2.0 or higher.

Price: Single-user, $195; five-user, $595; 25-user, $995.

Contact: The Software Link, Inc., 3577 Parkway Lane, Norcross, GA 30092, (404) 448-5465.

Inquiry 1010.

More than 200 Page Layouts for PageMaker

Layouts consists of 215 page-layout templates for business cards, letterheads, envelopes, brochures, newsletters, and flyers. This program for page designers using Aldus PageMaker includes seven borders for use with brochures, newsletters, and flyers. The templates include crop marks, fold marks, and registration marks.

With Layouts, you can import custom logos and other graphics.

Versions for the Macintosch and IBM PC versions of PageMaker are available.

Price: $179.95.


Inquiry 1013.

HyperCard with Sound, Music, and Multitasking

Intuitive Technologies’ UltraCard lets you collect and link information with HyperCard-like stacks in a multitasking environment while supporting color, sound, animation, and the Amiga’s video genlocking abilities. Because it supports Arexx, you can use UltraCard as a front-end control panel for vertical applications, letting you navigate through data stored in a spreadsheet, database, or stack.

UltraCard’s built-in scripting language, UltraTalk, is patterned after English, and it includes statements that run programs, play sounds, perform calculations and string manipulations, and manipulate properties in the UltraCard stack, the company reports. The program supports the command-line interface and the Workbench interfaces.

UltraCard runs on the Amiga 500, 1000, 2000, and 2500. It automatically supports NTSC and PAL (European) video standards. The program also supports external laser videodisk players.

Price: $49.95.

Contact: Intuitive Technologies, 2700 Garden Rd., Suite 6, Monterey, CA 93940, (408) 646-9147.

Inquiry 1011.

The FlexScan 9400 adjusts to horizontal scanning frequencies of from 30 to 65 kHz and 55 to 90 Hz vertically.
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A Lotus-Compatible Spreadsheet for Windows

Imagine Lotus 1-2-3 with pull-down menus, dialog boxes, and overlapping windows; what you’re seeing is Twindows, a Lotus-compatible spreadsheet for Microsoft Windows from Mosaic Marketing.

After working with a beta version, I found that Twindows is as true a Lotus 1-2-3 clone as Mosaic’s DOS spreadsheet, Twin. It successfully mimics all the functionality of Lotus 1-2-3 release 2.01. What makes Twindows special is not so much its menu bar, scroll bars, and right-click interface and point-and-mortise (or mouse-button presses) and time spent waiting for a redraw after some pop-up or pull-down. Those who prefer graphical interfaces, however, will find that the benefits far outweigh these minor inconveniences.

While building in support for graphics, Mosaic didn’t neglect keyboard users. A dedicated line on the display shows the current function-key mappings, and the menu bar is mapped to the “/” key, the same character used to activate the function menu in Lotus 1-2-3. The F1 key brings up a window of context-sensitive help, and you can select topics by clicking on menu items with the mouse.

Twindows imports and exports DIF, ASCII, and WKS files. However, Mosaic warns that various versions of Lotus 1-2-3 can’t read Twindows files and have to be translated using a dialog box utility that comes with the program. Twindows also includes an import/export option, “Twindows Print Format,” which lets you use the same print format with several word processors.

An added feature in Twindows is the page-preview mode, which lets you expand the default 80-column by 25-row view to 132 columns by 43 rows (with an EGA or higher). The font is tiny, and the entire page takes several seconds to repaint, but it’s still useful. The transport of data to and from other applications is covered through both the clipboard and an @DDE function call. The program also lets you assign colors to cells, based on their content. At 600K bytes, which doesn’t include Windows, Twindows is not a small program. Without expanded memory, the largest spreadsheet I could load was about 170K bytes.

Mosaic promises that the final release will include support for up to 8 megabytes of expanded memory but warns that it will work only with hardware-level expanded memory.

It seems logical that a Windows spreadsheet be capable of producing knockout graphs. Unfortunately, this is the one area where Twindows really misses the mark. You can create up to eight graph types with selectable type styles and fonts. The interface for creating the graphs is simple and versatile, but the graphs themselves are unimpressive. Users requiring presentation-quality graphs will have to resort to other means.

Those not familiar with Lotus 1-2-3 will be able to dive quickly into Twindows by following the tutorial lessons provided and by reading the well-written manual.

Twindows is what Mosaic promises it to be: a Lotus 1-2-3 clone for Windows. New users will find the point-and-click interface and thorough manual will help them come up to speed quickly, while Lotus 1-2-3 users will have to choose between a fast interface and an attractive one. Twindows isn’t Excel, but those who need tight Lotus 1-2-3 compatibility will trade some of the bells and whistles.

—Tom Yager

continued
QMS Brings Presentation Manager to Paper

One of the biggest problems with OS/2’s Presentation Manager (PM) is that it’s been a graphical user interface that was all dressed up with no place to go. Just try to translate all those spiffy colors and multitudinous fonts that you see on the screen to paper. WYSIWYG it’s not.

But QMS has taken a giant leap in bringing the possibilities of PM to paper with the QMSWriter PM10, a full-color thermal printer that interfaces directly with OS/2’s GPI (graphical programming interface) layer. The GPI, which is responsible for the “look and feel” of PM and its applications, is a complex and powerful part of OS/2. Other printers can’t communicate directly with the GPI, and they require an intermediary printer driver. But many developers have found to their chagrin that writing full-featured printer drivers for OS/2 is what’s politely termed a nontrivial undertaking.

Of course, connecting a printer directly to the GPI requires an abundance of processing power. The PM10 comes with its own custom add-in card (either AT bus or Micro Channel) that uses Texas Instruments’ powerful TMS34010 graphics processor running at 60 MHz. There’s also a hefty 7 mega-bytes of RAM on the board for preparing images for the print engine.

Setting up the PM10 is easy. However, for those of us used to traditional toner cartridges or printer ribbons, loading the huge rolls of wax-based ink film is an unfamiliar but far from difficult process. And there’s no ink mess either because the ink can melt only from the extreme heat that is used by the thermal printing head.

Installing the software was also easy, although I had to “fool” OS/2 by associating the PM10 with an unused printer port. Once in a PM application, it takes about a minute for the PM10 to print a page. And although that sounds like a long time, the printer starts to work almost immediately. With all that on-board processing power (and no intermediate driver), you experience none of the preprint pauses that I’ve come to expect when working with graphics images using laser printers.

If you think that thermal printers mean low-quality images, the PM10 is a big surprise. With its 300-dot-per-inch resolution and color capabilities, images produced by the PM10 almost literally jump off the paper. Admittedly, the specially coated heavy glossy paper that you need for the PM10 adds a touch of class, but the high-resolution color is the kicker.

The prerelease software that came with the unit I tested was a bit limited in its capabilities. By the time you read this, however, QMS says it will be shipping the final version, which will include 35 built-in fonts. More and more developers will be including direct GPI printer capabilities in their applications. And for more mundane printing jobs, the PM10 will also include standard Hewlett-Packard LaserJet and PostScript emulators.

With a budget-busting price tag of $9995, the PM10 certainly isn’t for everyone. The expendables (i.e., special paper and ink film) aren’t inexpensive either. It’s obviously a natural for serious graphics arts and presentation applications. The printer can also use special transparency film for overhead projection slides that are sure to impress. And using black-ink film and the transparency sheets, the PM10 (along with special software) can even produce four-color separations for color printing.

The PM10 is another step in making OS/2 and its still increasing repertoire of applications useful tools with real advantages over the old world of DOS. And if 1 grand is out of your ballpark, QMS says it will ship a black-and-white-only version this spring, which should sell for about half the price of the color version.

—Stan Miaskowski

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New and Improved Turbo Basic

Borland assigned the future publishing rights of Turbo Basic to original developer Robert Zale, who, along with Spectra Publishing, will be releasing a new version of it. I was able to take a look at a beta version of the new product, PowerBasic 2.0, although the library, help files, and sample programs I’d come to associate with Borland products were not yet available.

The look of PowerBasic’s main menu and window bears an obvious family resemblance to the latest versions of Borland’s Turbo C and Turbo Pascal. When you run the compiler, all you see is PowerBasic’s main window and main menu; the clutter of multiple windows in Turbo Basic is gone. Otherwise, PowerBasic functions much the same as its predecessor.

As a superset of Turbo Basic, PowerBasic 2.0 has many new features, commands, and functions that give it substantially more power and convenience. For example, it has binary coded decimal fixed- and floating-point data continued
Embedded systems designers have already used CrossCode C in over 577 different applications.

How to choose a 68000 C compiler for your ROMable code development

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4. Optimized Code: CrossCode C uses minimum required precision when evaluating expressions. It also "folds" constants at compilation time, converts multiplications to shifts when possible, and eliminates superfluous branches.

5. Custom Optimization: You can optimize compiler output for your application because you control the sizes of C types, including pointers, floats, and all integral types.

6. Register Optimization: Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as register, so you can instantly optimize programs that were written without registers in mind.

7. C Library Source: An extensive C library containing over 70 C functions is provided in source form.

8. No Limitations: No matter how large your program is, CrossCode C will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. 68030 Support: If you're using the 68030, CrossCode C will use its extra instructions and addressing modes.

10. Floating Point Support: If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. Position Independence: Both position independent code and data can be generated if needed.

12. ANSI Standards: CrossCode C tracks the ANSI C standard, so your code will always be standard, too.

There's More

CrossCode C comes with an assembler, a linker, and a tool to help you prepare your object code for transmission to PROM programmers and emulators. And there's another special tool that gives you symbolic debugging support by helping you to prepare symbol tables for virtually all types of emulators.

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types for 18-digit accuracy. The compiler also has extended-precision (80-bit) floating-point and Quadword (64-bit) integer data types.

You can compile and link separate source code modules for modular programming. Also, you can link assembly code or object code from other languages into your programs using object modules.

PowerBasic can generate either 8086/8088 or 80286 processor code, and it supports 80287/80387 math coprocessor code in your programs. It also has an optional procedure-based math package, and Spectra Publishing claims it performs IEEE-standard floating-point operations faster than a coprocessor emulator.

The integrated debugger lets you single-step through your code, set breakpoints, examine variables, modify expressions, and monitor the call stack during program execution.

Library stripping is one interesting feature of PowerBasic that lets you reduce the size of your executable file when compiling to disk. You can select which options to disable and remove code containing language features that are not being used in your source code.

This library stripping covers serial communications support, printer support, and all graphics support (i.e., CGA, EGA, VGA, and Hercules monochrome). You can select these options from the PowerBasic command line, from the Options section of the main menu, or by inserting a metastatement in your source code.

I tested library-stripping with HANOI.BAS, a 7034-byte sample program from the Turbo Basic 1.1 package. HANOI.BAS, which is a simulation of the Towers of Hanoi game, is an example of recursive programming. When compiled with Turbo Basic, my HANOI.EXE file was 39,642 bytes long. With all the options turned on in PowerBasic, I recompiled the program and got a file that was 39,570 bytes long. With all the options turned off, the same file compiled to a much smaller 36,130 bytes long—a savings of 3440 bytes. This feature can be especially handy if you’re trying to save RAM space or squeeze a lot of code onto one 360K-byte floppy disk.

PowerBasic is not just a rehash of the existing Turbo Basic package. It’s a new and much improved BASIC compiler.

My best compliments to Borland for letting a third party support Turbo Basic users. It’s good to see that Turbo Basic is resurrected and vastly improved.

—Stanley Wszola

---

**Artisoft Speeds Up LANtastic**

The Artisoft LANtastic network is well known for being a simple to use local-area network that is also inexpensive and amazingly efficient in its memory consumption. It has become an ideal system for small networks of IBM PCs that have a need to share printers, hard disk drives, NetBIOS-compatible network software, and even CD-ROM drives without tying up a system as a server. Last year, these qualities earned Artisoft’s LANtastic a BYTE Award of Distinction.

The only problem with LANtastic was that it was a bit slow, with an advertised speed of 2 megabits per second. People who wanted a higher-speed network would purchase Ethernet hardware from another vendor, but they would still make use of Artisoft’s incredibly compact NetBIOS code.

Now Artisoft has decided to issue its own Ethernet hardware, and it has done so at a price that makes it hard to pass up. The LANtastic Ethernet Starter Kit sells for $725, and it includes two half-length Ethernet adapters, a 25-foot piece of thin Ethernet cable, and the LANtastic code.
Take Our Course In C
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C's power and portability make it the language of choice for software developers. Unfortunately, learning C can be a very costly proposition. Classroom instruction is, in a word, expensive. And many C video courses carry hefty price tags.

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Requirements: IBM PC with 384K bytes of RAM (256K bytes without the spelling checker)

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### Features

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<tr>
<th>Requirement</th>
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<th>Mastermind Pro</th>
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### The Facts

PC-Write Lite was developed by Quicksoft, Inc. for $49. It is a word processor designed for the small business market, offering features such as spell checking, page layout, and document management. The program is known for its speed and ease of use, making it particularly popular among students and small businesses.

- **Specifications:**
  - **Display:** Monochrome
  - **Printer:** Any
  - **RAM:** 384K
  - **System:** 2.1 MB/DOS
  - **CPU:** 6008/6801
  - **Disk Storage:** 360/720KB
  - **Networking:** No
  - **Fields per Records:** 99
  - **Number of Records:** Unlimited
  - **Number of Files:** Unlimited
  - **Number of Dr Sorts:** 99
  - **Record Size:** 4960 BYTES
  - **Lineage:** Yes

expect to find in a word processor (e.g., mail merge, proportional fonts, and support for columns), but this is a calculated omission by the company. The program is aimed at the student or professional who wants a fast cursor to crank out memos, reports, and other prose.

I tested the beta version of PC-Write Lite against XyWrite 3.51, a full-featured word processor with a reputation for having a fast cursor. First, I did a search-and-replace operation in a 131,732-byte file. It took XyWrite 41.72 seconds for 533 occurrences; PC-Write Lite breezed in at 13.72 seconds. Then I did a word count (an especially important feature in the collegiate atmosphere) on the same file, a BYTE listings index. XyWrite took 24.50 seconds; PC-Write Lite took 4.34 seconds.

While PC-Write Lite won't stack up to XyWrite or WordPerfect in a features slugfest, it's obvious that this word processor is built for speed. But all the cursor speed in the world isn't much help unless the program is obvious to use. When you first start the program, you see a simple screen that displays information regarding the function keys. All you need to do is press F3, and you're ready to begin. Press F1, and you get a complete help menu with information on 45 different subjects, including formatting, page layout, footnotes, shortcuts, and basic editing.

Some of the help screens were empty, but that's to be expected in a beta version. Without looking at the manual, I was able to perform basic operations such as moving paragraphs and stripping out non-ASCII characters correctly the first time. Once I got used to the menu, which took only a few minutes, I was quickly moving in and out of files.

Two features, page preview and sending footnotes to the end of a file, were not implemented in my beta version, but the company says they'll be in the shipping version. Two other features, jump to line number and parentheses matching, are specifically designed for programmers.

With all the trimming Quicksoft did on PC-Write, the company still managed to save the important features for Lite. Block and box copy, move, and delete operations are supported. You can still split a screen to view two files at once and edit files as large as available memory. The spelling checker lets you check a given word, check each word as you type, or scan a file for misspellings. You can also add words to the word list.

The program supports basic font effects such as superscripts and subscripts, italics, boldface, and underline. For margin control, paragraphs can be ragged right, justified, centered, or flush right. PC-Write Lite doesn't support left and right page layout or parallel inde-pendent columns. When printing, you can print a range of pages in a file or a series of related files.

If you have simple word processing needs, I would recommend looking at PC-Write Lite. It's got speed, and the price won't burn a hole in your pocket.

—David Andrews
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Recently, Dr. Pournelle looked at Northgate's 80386 Pipeline Page Mode system and reported in BYTE July, 1989 (excerpted):

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Zenith's EISA Does It

With nine companies involved in its difficult labor and birth, the Extended Industry Standard Architecture has been lots of talk and little action until recently. Although EISA machines are starting to appear, few products actually plug into those nifty 32-bit slots.

But Zenith has pushed EISA further along with the Z-386/33E, an EISA machine built on the solid foundation of Zenith's proven 33-MHz 80386-based platform. And the company has gilded the system with a true EISA board. The 33E's disk drive controller is more than an upgraded AT-bus board; it's a new, unique design that gives a tantalizing glimpse of the type of performance improvements that EISA can provide.

Opening the Box

As I expected, the outside of the Z-386/33E gives little clue to the goodies packed inside. In fact, it's the same box as the Z-386/33 (see photo 1). Zenith has a well-deserved reputation for top-quality products, and the 33E's weight (45 pounds) goes a long way toward enhancing its built-like-a-tank stature.

That overall feeling of quality was validated after I removed the cover (see photo 2). This isn't some cobbled-together clone. From the heavily shielded power supply to the extra-large cooling fan to the motherboard, the 33E is a system that's designed for heavy-duty use in hard-driving corporate environments.

Sitting next to the CPU are two empty sockets for either an Intel 80387 or a Weitek math coprocessor. And the design uses 16K bytes of fast (15-nanosecond) static RAM cache memory with Zenith's singular 16-layer write queue.

Zenith included 4 megabytes of 80-ns 32-bit RAM in the 33E. That's about a minimum for the type of applications this
Making Disks Fly
On the all-important mass storage front, the 33E comes with either a 150- or a 320-megabyte MiniScribe hard disk drive. But it's the controller attached to the drive that accelerates the 33E beyond its competition. It supports up to 13 devices, including two floppy disk drives, four ESDI hard disk drives, and seven SCSI disk drives (daisy-chained from the single SCSI port). And because it's an EISA controller (and configured from disk), there are no pesky DIP switches to deal with. (The prototype that I tested had one set, but Zenith says that it will disappear in the shipping version.) Nice as it is, however, it's just the beginning.

To underscore the distinctive position of the system's EISA disk drive controller, Zenith has applied for seven patents on its technology. The controller is built by Data Technology Corp. (DTC) and is certainly imposing in its presence. In addition to the main controller board, there's a large daughterboard attached, along with a "stepdaughter" board. Zenith says that initial shipments of the controller will have the three-board configuration. But within several months, through the use of gate arrays, all the circuitry will get packed into two boards.

It's not hard to see why Zenith went after the disk drive controller as the first add-in board to take advantage of EISA's capabilities. Despite the emphasis on 33-MHz processors, disk I/O is one of the most critical components of overall system performance. EISA's increased bandwidth offers lots of potential to deliver data to the processor much faster than the AT's wimpy 8-MHz bus speed, but fast-access hard disk drives and 1-to-1 interleave disk drive controllers alone are not good enough.

Caching In
Although it's far from a new concept, Zenith's first line of defense against slow-disk malady is hardware caching. The controller comes with a megabyte of on-board cache. (It's expandable to 4 megabytes.) Zenith uses a variety of sophisticated (and proprietary) algorithms hard-coded into the controller to let it figure out where the next needed data will come from. The process is helped along by two processors on the controller: A venerable 8-bit V20 administers the cache, and a proprietary processor developed by DTC handles the interface between the controller and the drives.

But the most interesting aspect of Zenith's EISA controller is its position sensing, which allows the controller to know how close the drive's read/write heads are located to the data, by head position as well as where the hard disk platters are located in their rotation.

Position-sensing (one of the technologies for which Zenith has applied for a patent) doesn't make much difference in a single hard disk drive system. But once you connect multiple drives to the 33E, the whole picture changes dramatically. When "looking" at more than one drive, the Zenith controller uses its position sensing to get data first from the drive that's closest to starting its transfer.

Position sensing leads to an apparent paradox: The more drives you attach to the 33E, the faster and more efficient the system becomes. But even with a single disk drive attached, the 33E is no slouch. Overall, Zenith claims that the 33E can transfer data at 15 megabytes per second.

DTC says that it will soon offer a stand-alone version of the Zenith controller, but it won't include Zenith's position sensing. Position sensing will be available only in Zenith systems.

Plainly, the 33E is designed with the future in mind. In addition to its patent-pending features, the controller can, with the right software, act as bus master. This makes it a natural for multitasking applications and environments such as networks, OS/2, or Unix.

The Bottom Line
Of course, all this power doesn't come cheap. The Z-386/33E lists for $11,999 ($13,799 with a 320-megabyte hard disk drive). But a system of this type isn't designed for individual users, "power" or no. It will quickly find a happy home as a file server or even as a replacement for the corporate minicomputer.

Zenith has taken a giant step toward securing the future success of EISA. What makes the Z-386/33E so tempting is that its heart is built on proven technology. Its EISA disk drive controller is added muscle. Even if you think that you really need an 80486-based system, it's hard to see how it would give you more than marginally better performance over that of the 33E. For some time to come, the 33E is likely to be the standard by which other systems are measured.

Stan Miastkowski is a BYTE consulting editor, managing director of K+S Concepts (a documentation and consulting firm), and editor of the OS Report newsletter. He can be reached on BIX as "stann."
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<tbody>
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<td>STANDARD 150</td>
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<td>TURBO 375/450</td>
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Last month Motorola announced the availability of its newest 32-bit microprocessor, the 68040. Manufactured with 0.8-micron high-speed CMOS technology, the 68040 packs 1.2 million transistors on a single silicon die. With 900,000 extra transistors to work with over the 300,000 transistors in a 68030 processor, the 68040's designers added new features and boosted performance. These new features include the following:

- Optimized 68030 integer unit. While retaining object-code compatibility with previous 68000-family processors, the IU has been optimized to execute instructions in fewer clock cycles (i.e., run faster). The claimed boost in performance is three times that of a 68030.
- Integral FPU. The 68020 and 68030 require external FPU coprocessor chips to handle floating-point math. The 68040, however, has an FPU built into it, giving it the power to do serious number crunching. The FPU's data types are compatible with the ANSI/IEEE 754 standard for binary floating-point math, and its instruction set is object code-compatible with Motorola's 68881/68882 FPIs. Like the IU, the 68040's on-chip FPU has been optimized to execute frequently used instructions using fewer clock cycles. The claimed performance boost is 10 times that of a 68882.
- Large caches. Processor accesses to the system bus are minimized by storing the most recently used set of instructions or data in on-chip, 4K-byte caches. Both caches operate independently but can be accessed at the same time. Bus snoop logic is used to maintain cache coherency (i.e., it ensures that the cache's contents match those parts of memory corresponding to the cache). The bus snooper's design is fine-tuned to support multiprocessor systems where one or more bus masters or 68040s might share the same section of memory.
- Separate memory units for instructions and data. Each memory unit consists of a memory management unit, a cache controller, and bus snooper logic. The MMUs use a subset of the 68030's MMU instruction set. Both memory units function independently of each other to improve processor throughput.

The 68040 ships with an initial clock speed of 25 MHz; higher speeds are to be available in the future. The 68040 comes in a 179-pin grid-array package. With the elimination of coprocessor function lines (now that the MMU and FPU are consolidated onto the processor) and the addition of snoop control lines, the 68040 is not pin-compatible with the 68030.

Because of the 68040's software compatibility with its predecessors, it can tap into the existing software base of 680x0 applications. It does this not only while eliminating a component (the FPU) from a computer's design, but also while improving performance. In fact, the 68040 executes instructions on the average of nearly once per clock cycle—the same as a RISC processor.

This new CISC microprocessor offers RISC performance.

continued
Fine-Tuned for Performance
The 68040 was built on the firm foundation of its predecessors. The design team used the experience garnered from developing earlier processors to aid in optimizing the throughput of the 68040.

The 68040 was redesigned from the ground up. It incorporates a high degree of parallelism using a number of internal buses. An internal Harvard architecture gives the processor full access to both instructions and data (see figure). Both the IU and FPU have separate pipelines and can operate concurrently. For example, the FPU can perform floating-point instructions independently of the IU. Each stream (instructions or data) has its own dedicated cache and MMU that function independently of each other. A smart bus controller assigns priorities to bus traffic to and from the caches.

There were several key areas where performance was boosted. The first was in reducing the clock cycles needed to execute certain instructions. The next was to ensure that the processor funnels instructions and data into itself quickly and constantly, lest it stall while waiting on information. The processor then gets its results back into the system without interfering with incoming information. Finally, as if this wasn’t enough, the processor stays off the system bus to a greater extent than is the case with other processor designs. This lets DMA transfers and other bus masters have use of it.

The IU was optimized so that high-usage instructions execute in fewer clock cycles, particularly branch instructions. Motorola performed thousands of code traces using real-world applications to determine which instructions were used most often. The IU consists of six stages: instruction prefetch, decode, effective address calculation, operand fetch, execution, and writeback (i.e., the result is written to either a register or memory). Each stage works concurrently on the instruction pipeline. Dual prefetch and decode units deal with the branch instructions: One set processes the instruction taken on the branch, and another processes the instruction not taken. In this way, no matter what the outcome, the IU has the next instruction decoded and ready to go without seriously disrupting the pipeline. This complex design has a big payoff: Motorola has determined that the average instruction takes 1.3 clock cycles to execute. The ability to execute an instruction once per clock cycle is the performance edge of RISC processors—yet the 68040’s IU accomplishes the same goal while executing complex-instruction-set computer (CISC) instructions.

A Harvard architecture provides separate paths for instructions and data.
The FPU adds 11 registers to the 68040 register set: Eight of them are 80-bit floating-point registers, and three are status, control, and instruction address registers. The FPU has a three-stage execution unit, and, like the IU, each stage operates concurrently. Load and store instructions (FMOVE) can be performed during other arithmetic operations, and a 64- by 8-bit hardware multiplication unit speeds many calculations. However, the FPU only implements a subset of the 68882 instructions on-chip. The transcendental (trigonometric and exponential) functions are emulated in software via a software trap. But Motorola claims that even these instructions should execute 25 percent to 100 percent faster on a 25-MHz 68040 than on a 33-MHz 68882 FPU.

Boosting Throughput
In the area of throughput, each stream is managed by a separate memory unit that uses an MMU for logical-to-physical address translations during bus accesses. These MMUs support demand-paged virtual memory. Both MMUs have a four-way set-associative address translation cache with 64 entries (versus 22 entries for the 68030). The ATCs reduce processor overhead by storing the most recent address translations. When an address translation is required, the ATC is searched, and if it contains the address, it is used immediately. Otherwise, a combination of high-speed hardware logic and microcode searches the translation tables located in main memory.

Like the FPU, these MMUs implement a subset of the 68030's MMU instruction set. Gone are the PLOAD and PMOVE instructions, because enhanced existing instructions made them superfluous. Also, only two memory page sizes are supported, 4K and 8K bytes, whereas the 68030 MMU supported eight page sizes ranging from 256 bytes to 32K bytes. A design trade-off was made here: A performance gain was possible by supporting only the two most common page sizes. In any case, this change impacts only operating-system code, since MMU instructions aren't normally used by applications.

The two on-chip 4K-byte caches improve processor throughput in two ways: They keep the pipelines filled and minimize system bus accesses. To see how this is done, you must examine the structure of the cache. Each is a four-way set-associative cache composed of 64 sets of four lines. A line consists of four long-words, or 16 bytes. Cache lines are read or written rapidly using burst-mode access (a type of bus transfer that moves 16 bytes in a minimum of clock cycles). For read operations, this fills the cache efficiently and, at the same time, loads adjacent instructions or data into the cache that could be used in the near future.

Zen and the Art of Cache Maintenance
As the cache is accessed and data modified, cache-mode bits in the ATC determine, on a page-by-page basis, the method by which the information is handled. That is, the ATC entry that corresponds to the address in main memory whose contents were copied into the cache decides how the data will be updated. The modes are cacheable write-through, cacheable copyback, noncacheable, and noncacheable I/O.

In the cacheable write-through mode, an update to the data cache forces a write to main memory. While this generates additional bus activity, this mode is required when working with a portion of memory that other processors share. The copyback mode updates the cache line but without updating main memory. The modified (or "dirty") cache line is copied back into main memory only when absolutely necessary. "Noncacheable" indicates that the data shouldn't be cached, which is typically the situation for shared data structures or for locked accesses (e.g., an operand access or a translation table entry update). Noncacheable I/O indicates that the data can't be cached and must be read or written in the exact order of instruction execution. This mode is for memory-mapped I/O devices (typically a serial device) where the information's order is crucial.

The bus snooper is used in multiple bus master situations where a noncaching bus master, such as a DMA controller, might modify the memory that is mapped into the 68040's cache. The bus snooper monitors the external bus and updates the cache as required.

Cache validity is handled on a line-by-line basis (i.e., a cache miss triggers a burst-mode access that updates 16 bytes either in the cache or main memory). The copyback mode minimizes writes to main memory, and the bus controller prioritizes each cache's external memory requests. Read requests take priority over writes to ensure that the pipelines remain filled.

The caches are critical to the 68040's overall throughput. They keep instructions and data moving into the processor while satisfying the apparently contradictory role of minimizing system bus accesses. Motorola estimates that the cache hit rate is about 93 percent for instruction and data reads and about 94 percent for data writes.

A Processor for the 1990s
It is perhaps appropriate that Motorola has introduced the 68040 in the first month of the new decade. The 68040 has the power to tackle the jobs with large amounts of information that we will be dealing with regularly in the 1990s.

Preliminary results have a 68040 weighing in at 20 million instructions per second versus the SPARC's 18 MIPS and the 80486's 15 MIPS, all clocked at 25 MHz. On floating-point operations, the 68040 anted up 3.5 million floating-point operations per second versus the SPARC's 2.6 MFLOPS and the 80486's 1 MFLOPS. If these numbers are accurate, then the 68040 already out-performs one RISC processor.

But the computer industry doesn't stand still. As we move into the new decade, we can expect new RISC processors to once again take the lead in performance. Still, the 68040 shows that owners of CISC systems can have their cake and eat it, too. They don't have to forsake their software base or settle for mediocre performance. And Motorola is already working on the 68050.

BIBLIOGRAPHY

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I'll admit that I'm not a speed freak, but I do enjoy working on a fast machine. When the first 80486 machines came into BYTE, I was quite impressed by the performance, and even more so by the price. At 100 pounds and $20,000 or more per machine, these critters seemed like toys of the idle rich, destined to become file servers or multiuser systems.

Club AT's Hawk II (see photo) is built for a single user. It comes in a standard tower case with room for one full-height and four half-height drives. Power comes from a single 250-watt power supply, mounted high in the case. Along with the standard cooling fan, a second, filtered fan is mounted near the card slots to help out with the cooling.

While most of the 80486 machines have tons of extra security features, the Hawk has none. The case is held together with three screws, just like any standard tower machine. Also, there's no reboot or power protection. A small plastic door covers the power and reset switches, but it's only for aesthetics and accidental reboot protection.
There’s no overkill in configuration, either. Other manufacturers have decided to have their 80486 machines sport exotic disk drive controllers and memory configurations. Club AT equips its Hawk II with 4 megabytes of paged memory, a 128K-byte CPU cache, an 85-megabyte Maxtor modified-frequency-modulation hard disk drive, an Everex Viewpoint VGA card, a monitor, a keyboard, and your choice of a 5¼-inch or a 3½-inch floppy disk drive. All this costs about the same as an equally powered 80386 machine—$4995. The only options added to this base package on my test machine were a second (3½-inch) floppy disk drive and a serial/parallel I/O card.

Elbow Room
If you need more options, there’s room for them. Sockets are provided for another 4 megabytes of single in-line memory modules, bringing the total RAM up to 8 megabytes. A 32-bit slot accommodates another 8-megabyte memory board at full clock speed. A coprocessor socket takes the Weitek 4167 math coprocessor.
The seven 16-bit slots give you room to add any Industry Standard Architecture (AT bus) cards. You might even consider extending the 128K-byte instruction cache to 256K bytes for an added performance boost.

My evaluation unit was a prototype; the final case tooling wasn’t available. My overall impression was that the Hawk II is built like a tank, certainly as well-built as any tower I’ve seen in some time. Club AT is still working on the front-panel bezel; the door covering the power switch was very stiff and hard to open. I wonder why the turbo LED was left on the bezel; there’s no turbo switch, and no obvious way to control the processor speed. Perhaps the final version will address that. Also, the power light on the front of the unit wasn’t working.

If I can nitpick about one last thing, it’s the keyboard. The Hawk II came with a typical clone keyboard. It felt mushy and had a very short cord. Happily, it’s a standard item, and you can re-place it with any keyboard you like. I’ve never understood why people sell tower cases with short keyboard cords.

Fast? You Might Say That
On the BYTE low-level benchmarks, the 25-MHz 80486 was able to hold its own against all but the fastest 80386 machines. The table above shows the performance indexes of the Hawk II, the Apricot VX FT 486, Advanced Logic Research’s FlexCache 33/386, and the Compaq Deskpro 386/33. A casual observation of speed suggests what I expect the formal applications benchmarks will show—the Hawk II is as good as the best of the 33-MHz 80386 machines. Windows/286, which is normally quite nice on the Compaq 386/33, paints the screens in a visible motion. On the Hawk II, you select a function that repaints the screen, and the image is there instantly. As Windows does a lot of memory moves to handle its graphics, I suspect that the 80486’s superior string handling has a lot to do with the fast graphics. Other graphics applications showed similar improvement.

I would like to see more machines like the Hawk II. When the 80486 was announced, Intel said that the 80486 architecture would allow machines that outperform the 80386 and cost less. The Hawk II is the first machine (of many, no doubt) that fulfills this prophecy. If I were in the market for a high-end 80386 machine, I’d give this personal 8046 system a look. Perhaps when my 16-MHz 80386 dies, I’ll buy one myself. The Hawk II is a good piece of equipment, and compared to the other 80486es I’ve seen, you can have it for a song.

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OPTICAL DISK DAZE

From dusty WORMs to cows-on-disk, there’s been a whole lotta optical happenings at Chaos Manor

You can be sure of one thing about small computers: few things are ever as simple and easy as you expect them to be. Case in point: we recently sent the Maximum Storage APX-3200 WORM (write once, read many times) drive back to be refurbished. I’d been using it for over a year with no problems; then, suddenly, I got retry errors. No data was lost, but it was worrisome, so I took it apart.

It didn’t take long to find the problem. The external drive case had real filth at the air intake, and the fan drew air past the laser mechanism. I was actually getting dust balls! The laser could usually see through them, but sometimes not. Once I figured out what was happening and vacuumed the innards of the drive, the problem went away. Then I called Maximum Storage.

It seems they had also only just discovered the difficulty. They had two remedies. First, they have changed the fan placement so that the problem isn’t likely anymore; and second, they started an annual cleaning and maintenance service for WORM drive owners. “Send yours in,” they said. “We’ll clean it up, and while we’re at it, we’ll upgrade it to an APX-5200.” The storage capacity of the APX-5200 is much greater than (500 megabytes per side versus 122 megabytes per side) that of the APX-3200, but the APX-5200 can still read and write to the older disks. Upgrading was clearly a good idea, the only drawback being that I’d be without the WORM drive for a few weeks, but I had a trip scheduled in that time period anyway.

The trip, incidentally, is more proof that things associated with computers seldom go as planned. It was to the fifth annual Hackers’ Conference, followed by a meeting in Palo Alto with BYTE’s senior editorial staff. This put me in the Bay Area precisely in time for the earthquake, which upset me less than it did the BYTE people. After the quake, I got into the Bronco II and drove home without incident. The BYTE staff fought their way to the San Francisco airport and flew out just in time to be trapped by a blizzard in Chicago.

The B: Blues
The APX-5200 looks identical to the APX-3200, except that the controller board is a tad larger. It comes preset so that installation is simplicity itself: put the board in your machine, put the installation disk in your floppy disk drive, type Install, and answer the questions. At least once it was that simple for me, but not this time.

My Big Cheetah 386 has, in addition to the WORM drive, an Amdek Laserdek CD-ROM drive. That comes addressed to the same I/O channel as the default address for the WORM drive. Because Maximum Storage’s documents and software are really well thought out (some of the best I’ve seen), it is considerably easier to readdress the WORM drive than the CD-ROM drive. All you have to do is flip a DIP switch on the board. Then, when you run the Install program, the software finds where the controller is addressed and adjusts itself accordingly. Once again, I’d used it before, and it was painless—but not this time.

In the past, the software came on a 5¼-inch disk. This time it was on two 5¼-inch disks, but a 3½-inch disk was also included. Since Big Cheetah has both drives, I figured I’d use the 3½-inch floppy disk, so I put that in drive B, logged onto B, and typed Install. For a few moments all was well—then the program tried to make copies from drive A, and nothing I could do would induce it to believe that it should look to B. Eventually there was nothing to do but reset the machine.

Alas, one of the things the Install program does is to make changes in your CONFIG.SYS file—and it hadn’t finished doing that. I’d reset with the file not closed. The result was utter garbage in the CONFIG.SYS file, which meant it was now time to find the emergency backup boot floppy disk for Big Cheetah. If you haven’t made an emergency backup boot floppy disk for your system, stop reading this article, go to the machine, and make one now. If you don’t know how to do it, find someone who does. Then keep it somewhere near the machine.

Maximum Storage was feeling sheepish about the Install program, as well they might. They’ve fixed it, of course; and perhaps it can be a lesson for any software designer reading this. There aren’t many reasons why an Install program shouldn’t run off any disk drive, floppy or fixed.

When we got the machine rebooted up properly and the CONFIG.SYS file taken care of, we found that DESQview wouldn’t come up.

Tweaking DESQview
DESQview, for those few who don’t know, is a multiwindowing program that lets you switch from one job to another without saving them off to files and reloading. When used with its companion memory manager QEMM-386 and run on an 80386 machine—or an 80386SX, or an 80286 that has been upgraded with the All Chargecard—DESQview can make full use of your extended memory as well as expanded memory.

Moreover, DESQview can stuff a lot of things, including itself, into unused memory areas between 640K bytes and 1 megabyte. That extended memory below...
1 megabyte—to coin a less confusing name for it, I'll refer to it as 640+ memory—is special, in that it's easy for DOS to address it. It's therefore precious, and you need to conserve it.

What I want from DESQview is access to the CD-ROM in at least one window, access to the WORM drive from all windows, and at least five large, say 520K-byte, windows running at once. As it happens I can just do that, so it was dismaying to find that I couldn't with the new Maximum Storage software.

Fortunately, my son Alex was able to fix that by tweaking the CONFIG.SYS file. As a result, I can once again run the following:

```
DEVICE=LOADHI.SYS
C:\BIN\AMDEK.SYS
/W:\D:\AMDEKCD
DEVICE=LOADHI.SYS
C:\MAXSYS\MAXBIOS.SYS
\1/200
DEVICE=LOADHI.SYS
\MAXSYS\MAXSYS
```

which loads those three drivers into the 640+ memory. I can then run the following:

```
C:\BIN\MSCDEX.EXE
/D:\AMDEKCD /M:8
```

inside a big DESQview window. I then have N as the WORM drive, which is available in all windows; and O is the CD-ROM drive in that window (but no other). Since DESQview has a mark-and-transfer program, I can cut and paste text from CD-ROMs into any other window, including communications windows, and for that matter, this one.

What Alex did was set up the basic CONFIG.SYS statement:

```
DEVICE=O:\\LOADHI.SYS
C:\BIN\AMDEK.SYS
/W:\D:\AMDEKCD
```

and reset, and then run QEMM.COM to look at the memory map it generates. From that, he deduced that certain memory areas have to be excluded, so he excluded them all. The result was to add $A000-$9FF to the DEVICE=QEMM.SYS line and reset. When that worked, he began to whittle off the excluded areas until making to load DESQview sent the system off into the land of lost bits. He kept this up until we discovered that all we need is $C000-$7FF to make things work.

That particular exclusion may not work for you—in fact, if you have a Z800, I guarantee you'll have to exclude a larger area—but you can still use the general method to build the largest possible DESQview window.

The CD-ROM Scene

One neat thing about CD-ROM drives is that you can daisy chain them; at least you can if they're all Hitachi drives (which the Amdek Laserdek is). I have seen a stack of four, with the Oxford English Dictionary in one of them. When you try to access the OED, you can see each drive light come on in turn, until it hits the OED. Alas, that was only a test. I don't have four Hitachi drives, and given the cost of CD-ROM drives, it's unlikely that I will for a while. I am getting a second one, though, so I'll probably keep a Microsoft CD-ROM (Bookshelf alternating with Programmer's Library) in one of them.

CD-ROM drives cost too much. The good news is that prices are falling at about 10 percent a year. I wish I had better news.

There are a lot of new CD-ROMs, so many that it's nearly impossible to keep up with them; I must get half a dozen a month. Many are quite interesting. Some are downright odd.

Example: BYTE is located in one of the largest buildings in Peterborough, New Hampshire, a five-story brick affair. In its early years, BYTE shared the building with the American Guernsey Cattle Club. After the guernsey group moved to Columbus, Ohio, the building wasn't redecorated for some time. As a result, anywhere you looked you'd find pictures of cows, and literature about cows, and posters featuring cows. And it was the custom never to explain that to visitors.

Most of the cow clutter is gone from Peterborough, but here at Chaos Manor I still have my picture of The Ideal Type Guernsey Cow on the wall above the Mac II. (Don't ask.) Now Quanta Press has sent me a CD-ROM called About Cows, along with a framable certificate proclaiming me a member of the Cow Moo Nist Party of the U.S.

This CD-ROM will tell you just about anything you ever wanted to know about cows, from serious articles about artificial insemination (how to do it, and when not to) through poems (“Then there are cows, who love to boast, of affairs they've had by parcel post”) to a still picture of the scene from the 1983 PBS production of “Swan Lake Minnesota” showing a line of classic ballerinas in tutus standing in dairy stalls waiting to be continued...
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CHAOS MANOR

milking, and I think I don’t want to say anything more about that. Half of About Cows is spoof; the other half is quite serious, and it would be useful to dairy farmers.

Another CD-ROM from Quanta Press is Dick’s Some of the Earth’s Planes. You may find that name similar to a better-known series of publications about military hardware. As is traditional with CD-ROMs, the installation program is confusing, there are no instructions for installation, and the retrieval software is hard to use. However, with enough patience, you will eventually be able to get it to show you a series of pictures of military aircraft.

The most interesting CD-ROM I’ve got in the last couple of months is called Between Heaven and Hell. Created as a showpiece to advertise a company that has, alas, foundered, this CD-ROM contains 145 megabytes in 10,429 files. These include the title files: the King James Bible with concordance (Heaven) and some scanned images of nudes in various naughty to raunchy poses (Hell).

There’s also just about everything else you can imagine, most either shareware or public domain. There is a shareware game of Risk. There is a whole slew of desktop publishing software. There are word processors. There is a bewildering variety of retrieval software. There are math and chemistry tutorial programs, a family-history tracking program, communications software, and a hypertext development system. You name it, it may be on there.

I say “may be”: there are over 300 catalog files on this crazy disk, and I haven’t had a chance to look at them all. Just trying to can eat time. I have looked at enough to know there’s a bewildering variety of programs and images.

The Bureau of Electronic Publishing (a private company despite the name) sells this thing for $99, and my recommendation is that you get your club or users group to buy a copy. There’s something on there for every member. With 10,429 files, how could it fail?

**XTreePro Gold**

Although there’s a variety of retrieval software on Between Heaven and Hell, none of it is very good. Actually, that’s probably not true; let’s just say that I don’t have time to figure out how to make it work right. In hopes that they could help with the retrieval software, I called the Bureau of Electronic Publishing. They told me what they did was to use XTreePro Gold to examine the disk and peel off parts as wanted.

By coincidence, I’d recently had correspondence with XTree’s representative, so there was a copy on my desk. No time like the present, I thought, and installed it. That went all right. Then I logged onto the O drive.

XTreePro Gold does statistics on every file—not on every file in the current directory, but every file on the entire disk. That’s why I know the exact number of files and bytes on Between Heaven and Hell. That does take time: 7 minutes, to be exact.

Once done, though, it was pretty impressive. There was a full diagrammatic display of the CD-ROM directory structure, and it was easy and quick to move among those directories. Then I wanted to find the number of catalog files on the CD-ROM. XTree lets you change the file specifications, so I set that to *.CAT* and let it go. It trundled for 3 minutes and told me it was out of memory. I was eventually able to get the answer by exiting DESQview, stripping my system down to bare bones, rebooting, and then running XTree, but it was hardly convenient. Still, I could do it.

A CD-ROM with 10,000 files on it isn’t the average problem a directory utility is designed to work on, so I tried the program on different logical directories of my 300-megabyte Priam hard disk drive. I keep that drive partitioned into three logical drives because I’m still using DOS 3.3, and while SpeedStore and other programs let you have larger logical drives, I run so much new and different and even oddball software that I like to keep things as standard as possible. XTree works fine on normal disk drives. It takes a few seconds to get all the disk statistics; it then shows you a full diagram of the directory structure and tells you how many total bytes make up how many files for the entire drive.

Unfortunately, what it tells you is not exactly wrong, but—well, it’s best you listen to the story.

The obvious thing to compare XTree with is Norton Commander, the DOS utility I normally use. I put that in one DESQview window and XTree in another and logged both onto the XTree subdirectory. Actually, you can’t really log XTree onto a subdirectory; more on that in a moment.

Anyway, both programs told me there were 8.03 megabytes of free space on drive C—and that was the only thing they agreed on. Norton Commander knows that there are 33.2 megabytes on the C logical drive, of which 8.03 are free and 25.2 are used. Norton Commander does continued
not tell you how many total files there are on the drive. XTree doesn't tell you the total drive size, but it does report that I have 1664 files using 23.3 megabytes. CHKDSK reports something different from both XTree and Commander because it breaks the files down into 5328 bytes in three hidden files, 139,264 bytes in 59 directories, and 25.06 megabytes in 1662 user files. None of these add up properly.

XTree and Commander don't agree on how large the XTree subdirectory is: XTree claims there are 772,287 bytes in 40 files, but Commander reports 41 files using 817,152 bytes. On the number of files, they're both right; that is, Commander counts the "." file while XTree doesn't.

I didn't feel like adding up the numbers on the byte count, so I went to a smaller subdirectory with only a few files. XTree reports there are three files with 6128 bytes. Commander reports four files with 10,240 bytes; but if you tell Commander to select all files, it says there are three with 6128 bytes. That prompted me to take Commander over to the XTree subdirectory and try again.

Sure enough, selecting all the files there shows 40 files with 772,287 bytes. The upshot is that both programs will give you the right answer on subdirectory sizes, but you have to tweak Commander to get it.

Meanwhile, Commander, because it doesn't examine the entire drive, will let you look at the CD-ROM directory by directory without using up a whole day. XTree, alas, won't let you merely log onto a directory; it wants to tell you about the entire drive or nothing. The company does list a complex batch file that uses the DOS SUBST command to fool XTree into believing that a directory is the X drive, but it's in the manual, not on their disk, and it's never explained.

A call to XTree revealed there's another undocumented feature: you can use Alt-Z after the program has logged onto a drive, and it will save those drive statistics into a disk file and reload them the next time you log onto that drive. If you have changed anything on that drive, it has to do the statistics search again, but for a WORM or CD-ROM, that would be no problem—provided that you don't change cartridges. If you do, XTree sees something odd and reexamines the drive again. In the process, it erases the previous statistics file for that drive. This isn't right.

What XTree probably should do is save the drive statistics by volume name and look at that, or, failing that, let you force it to look at a particular disk file of statistics; but, alas, it won't do that.

In fact, that's my general conclusion about XTreePro Gold: it's a great toolkit of really well-written stuff, but just about the time you're ready to use it, there's a problem. The user interface is fine for most of what it does, but suddenly you're faced with typing in complex batch files. It could save you time with CD-ROM disks, but you can't get it to keep each CD-ROM on file. In a word, it's infuriatingly good. I'll leave XTreePro Gold on my drive because sometimes it's more useful than Norton Commander, but I don't think I'll use it all that much. I sure want to see the next revision, though; if they fix the problems, this could be the hot disk drive manager utility of the year.

Mac CD-ROMs

Before I leave the subject of CD-ROMs, I should mention that there are a whole
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bunch of them for the Macintosh.

I've previously discussed the Grolier Academic American Encyclopedia for PC compatibles. Now there's a version that works for the Mac Plus, the SE, and the II family. The encyclopedia database is identical to the PC version, but the access software is more Mac-like. I didn't get to keep my copy long. My youngest boy uses a Mac. He's on the UCLA debating team, and it took him about 30 seconds to decide that this was something he really needed, and "Dad, you've already got it for your computer." The problem is that he's also lost the CD-ROM drive for the Mac, but I'm supposed to get it back Real Soon Now.

He also took the Mac version of the World Factbook. This is published by Wayzata Technology and distributed by Quanta Press. It comes without a manual, but with a Mac floppy disk of retrieval software; as with most Mac products, you won't need the manual if you find the Mac intuitive, and a manual probably wouldn't do you any good if you're a Mac hater.

There's still nowhere near as many CD-ROM products for the Mac as for the IBM PC, which is surprising, because I'd have thought CD-ROM and HyperCard were made for each other. Still, there's more all the time.

**Grammatik IV**

It wasn't broke, but they fixed it anyway. They upgraded Grammatik, and Grammatik IV has the distinction of not working as well as Grammatik III did.

In fact, I can't use it. Version IV says that it fully supports Q&A Write—version III almost did, but it can't let you change the length of a line because of the odd file structure Q&A Write uses—but what happened when I aimed it at a Q&A Write file (this one, in fact) was that the program displayed a message, "Preparing Document," and trundled for 9 minutes, after which I gave up and tried to stop it. I couldn't.

The only way to turn the silly thing off was to close its DESQView window, which is equivalent to turning off the machine. I then found that Grammatik IV had created a file called BYTEFEB.$$G with 0 bytes in it, and another file called GK009560.$$G that had grown to 301,056 bytes when I stopped it.

When I saved my text as an ASCII file and aimed Grammatik IV at that, the program worked fine. The only difference I noticed between versions III and IV is that III has a somewhat better user interface. The new interface isn't all that bad, but the old one wasn't broke and didn't need fixing; it's now harder to get the program to read files on other logical drives.

Grammatik is still my favorite grammar and style program (but see last month's section on Scandinavian PC Systems' Readability, which is also necessary), and I suppose they'll fix whatever bug makes it unusable with Q&A Write; but for the moment I'll stick to version III unless I adopt a new word processor. I'm told that version IV works very well with WordPerfect and Microsoft Word, but I haven't tried it with those.

**Simulations and Games**

A week after the earthquake happened, we were up in the Bay Area again, this time attending the annual Computer Users in Education (CUE) conference.
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(for information, contact Computer Users in Education, 1923 Menalto Ave., Menlo Park, CA 94025, (415) 325-8934). Naturally, this is one of Mrs. Pournelle's favorites; indeed, if you're in education, you ought to get to it. The conferences, demonstrations, and just plain networking are excellent.

There's getting to be a lot of educational software. Alas, it's a mixed bag. Much of it doesn't seem very useful. Some programs, like Broderbund's Physics for the Mac, are excellent. Physics is just plain fun. It could, I guess, be used by an imaginative teacher for classroom demonstrations, but the main value would be in a lab situation in which the student could just play around with it. The animated simulations of concepts like harmonic motion are quite good. You can play with a pendulum to see what happens if you change the mass, or the length, or both. In another demonstration, you can see the molecules inside a sealed box and watch the pressure change as you add heat or change the box size. I'd have killed for this program when I was in high school.

Unfortunately, not all simulation programs work that way. A case in point is The Budget Process from Tom Snyder Productions, a program that is part of the Decisions, Decisions educational programs series. According to its literature, Tom Snyder Productions "specializes in group simulations that inspire cooperative learning across the K-12 curriculum." The company has an excellent reputation. Dr. Snyder gave the keynote speech at the CUE conference, and I thought what he said was well informed, sensible, and much to the point.

The Budget Process is a simulation program. The class plays the role of a member of Congress. In the words of the program book, "You were elected to the U.S. House of Representatives as an Independent....A small majority of the registered voters in your district are Republican, but the Democrats in your district are very vocal and influential. "You and a colleague of yours, Rep. Joe Bain, are the principle [sic] authors and sponsors of a federal budget bill, HR123."

The booklet is about 25 pages long, with about 300 words per page; not a very large book. The concepts dealt with are quite complex. Some of them are well done. Some are in baby talk. Some read like propaganda. Some of the entries are supposed to be propaganda.

The problem is that the game is supposed to simulate the real political and economic world—and unlike the physics of harmonic motion, we don't know how the real political and economic world works. Since the Nobel Prize in economics was instituted, there have been about a dozen recipients. I don't believe that any two of them agree on very much. Certainly I could get a number of them to disagree with the economic concepts taught by this program.

The same is true of political science. While I know of several congressional districts that have returned Republican members even though registered Democrats outnumber Republicans, I don't know of any district where Republicans outnumber Democrats but an Independent was elected. More to the point, an Independent representative wouldn't be authoring a budget bill.

Moreover, the choices offered this Independent are (a) meet with important

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(DEALERS: 163)

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Republicans, (b) meet with leading Democrats, and (c) wait and see. One of the Congressman's aides asks, "What will people think if they see you meet with the Republicans?"

The class is now supposed to discuss these choices and decide what to do. So far, so good: the discussion can't hurt them. Next, though, you must make a choice—and the game will tell you what happens next. I don't know what the game will decide. I do know that the outcome largely depends on the opinions and theories of the game's programmer.

One of the topics for debate in this simulation is the effect of tax cuts on the economy. The arguments for the Keynesian and supply-side positions are as fairly stated as can be, given that there's only a single paragraph for each. Once those arguments are read, there will be class discussion. Presumably the class will then choose whether to raise or cut taxes—and the game will tell them the consequences of that decision.

Once again, I don’t know whether the program will decide that the economy went boom or bust after a tax cut (or increase). I do know this: if the program was written by a fanatic Keynesian, deficit spending will stimulate demand, people will buy, and the economy will boom. If it was written by one of Laffer's followers, a tax cut will cause renewed investment, everyone will work harder, and the economy will boom. Which should the game decide? Then again, the program might consult a random-number generator. Whatever happens, the students will be learning more than we really know about economics and political science.

I don’t mean to pick on this particular program. It works harder at being fair than most.

Another case in point: Sim City by Maxis. This is a game that simulates city management. It’s a fun game (barring the fact that the IBM PC version has an annoyingly obtrusive copy-protection scheme). I’ll even concede that it has some instructive value.

Of course, some things aren’t very realistic: ships crash into bridges, airplanes fall into the business district, fires and floods happen with alarming frequency, tornadoes are common, and once in a while a big, green monster swims ashore. The rest, though, is supposed to be a simulation of reality—in particular, the interrelations among taxation rates, zoning, pollution, transportation, power plants, industrialization, and suchlike.

They’ve done a heck of a job with this. The animation is great, and the simulation is pretty convincing—and that’s the problem, because once again it’s a simulation of the designer’s theories, not of reality. Case in point: the designer prefers rail transportation to automobiles. It’s costly, but it doesn’t pollute. In fact, you can design a whole city with nothing but rail transport, not a single road in the place. In the real world, such a city would soon strangle in garbage.

Again, my point is not to condemn these programs. Instead, I want to warn against their misuse. For all too many, computers retain an air of mystery, and there’s a strong temptation to believe what the little machines tell us. "But that’s what the computer says" is a pretty strong argument in some circles. The fact is, though, the computer doesn’t say anything at all. It merely tells you what the programmers told it to tell you. The Physics program could be jiggered to
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yield highly plausible output even if the programmer didn’t know the laws of physics.

A few years ago, a “world-model” program predicted global doom. That program inspired the book The Limits to Growth, and soon we had “national malaise” and “an era of limits.” Today, we know things aren’t that simple. But we’d better be aware of their limits.

Simulation programs and games can be valuable tools to better understanding. One of the best things such programs could do would be to let the students know what the inner relationships are. I don’t know of any programs that let you fiddle with the equations inside the model, but I think that might be one heck of an educational tool.

**P.D.Q.**

One of the main complaints against BASIC is that even compiled BASIC programs tend to be large. Typically, the QuickBASIC version of a program will be about twice as large as the same program compiled with a really efficient C compiler. Indeed, now that BASIC has the standard control-flow statements required for structured programming, code size and efficiency are the major rational arguments favoring C over BASIC.

Modern C compilers aren’t as efficient as the old ones. The fact is that a lot of C code isn’t much smaller than what you get with QuickBASIC 4.5. Leave that for another time. The conventional wisdom is that C gives you smaller and faster programs than anything but assembly language.

Enter Crescent Software’s P.D.Q., a replacement linking library for QuickBASIC versions 4.0 and higher. The procedure is to write and debug your program in the QuickBASIC environment, compile it with QuickBASIC’s BC.EXE compiler, and link it using the P.D.Q. library rather than the one furnished by Microsoft. The result will be code from a third to a sixth as large as that produced by the standard QuickBASIC library, with corresponding improvements in execution speed. P.D.Q. programs are usually considerably smaller than the same programs written in C, sometimes approaching the size you’d get using assembly language. They’re also a lot more readable than C or assembly language.

The result is highly increased productivity. The QuickBASIC environment is conducive to rapid output of debugged code; code, moreover, that you can read six months after you wrote it. Of course, professional C programmers say they can read their C code six years after they wrote it, and I have no reason to quarrel with them; but I certainly can’t do that.

Like many part-time programmers, I can’t work on code for any long period of time, or even regularly. I have to make do with a few hours here and there, interrupted by long periods when I don’t get to look at the code at all. Under those circumstances, I find that if I use C, I spend...
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last fall was a bad time for the U.S. computer business. On October 17, the almost but not quite “big one” (elsewhere they call them earthquakes) hit Northern California and creamed many Silicon Valley computer companies. Analysts across the country predict that if the Valley companies don’t move to more stable seismic territory, the U.S. computer industry will literally be buried when the really “big one” hits.

If this weren’t bad enough, a few days later IBM and Digital Equipment announced that their third-quarter sales and income were way down. Wang, Unisys, and Tandem announced they were again cutting their labor forces, which meant that more good people got fired. To top this glorious week off, Time magazine told us that the U.S. computer industry was down-and-out.

Now, this doom-and-gloom stuff makes for interesting reading, especially to a great many Americans who are puzzled or downright confused about the computer industry’s own unique culture. Despite those earnest feelings, the U.S. computer industry is not failing. Stumbling? Most assuredly. Needing to refocus its development efforts? You bet. Scaling back to a more normal business-growth pattern? Certainly. But doomed? Not a chance.

The Fine Art of the Update
There’s hardly anything in today’s personal computer market more gratifying than the natural evolution of good software. It’s one of the reasons that I’m so optimistic about the future, and why I consider the doom-and-gloom scenario to be based on a serious misreading of the way technology development proceeds.

The Macintosh is one software platform where meaningful, real software updates seem to come out with some regularity. Software vendors seem to actually listen to their customers and add the features they want, fix the bugs they want fixed, and generally advance the state of the art—if only a little at a time.

I can think of three good Mac programs that I’ve grown attached to and use all the time: Nisus, Symantec Utilities for Macintosh (SUM), and AppleLink. I’ve reported on their strengths and weaknesses here. And I’m happy to report that all three have been updated and revised in the last few months.

Nisus
Nisus, the programmable word processor from Paragon Concepts, is my everyday editor. Without it, writing this column would take much more effort on all the time-wasting details of spelling checking, continuity checking, punctuation, and the other technical details of writing. Version 1.0 was a laudable first effort, but it had weaknesses. The most notable were some intermittent updating problems (e.g., the screen would jerk along if you typed too fast), the inability to break a single document into multiple windows without opening several versions, and lack of footnotes. The latter was a real killer for academic users.

Version 2.02 fixes all those deficiencies, and it also runs faster. It scrolls faster, saves files faster (including autosaving), and jumps between the main text and print-preview windows faster. In short, Paragon Concepts extended its already good program without junking it up with a lot of bells and whistles.

Still, there’s room for improvement. A real outliner should be incorporated, and the already large set of prebuilt macros should be expanded to cover lots more punctuation and editing quirks that often need to be fixed in a document.
SUM II
I have an intense love/hate relationship with SUM. On one hand, I love it because I've used it to recover files from disks that have gone belly-up. On the other hand, I hate to have to use it, since the stupid disk shouldn't have crashed in the first place.

SUM I was a good program, but it suffered from a quirky interface that was hard to use even if you read the manual. SUM II didn't do a solid job on disks whose directory structures had been flattened. Its writing of a second shadow directory on the file sometimes worked, but more times it did not, leaving you the single alternative of pulling off your files and directories with little structure left.

SUM II has changed my feeling about SUM entirely. While I still don't like to have to use it, at least now I don't hate the feeling, since I've seen the program pull a couple of disks back from the brink with nary a missing file or folder.

The new SUM incarnation refines the interface and how it operates, at the same time offering many new file protection and recovery features. It manages to do all this while still being much easier to master than the first version.

Its recovery prowess was pretty impressive. In fact, I put it to work on the Jasmine DirectDrive 140 that died on me a while back. I had used SUM I to pull the unstructured files (most of them, that is) off the disk, but I had never bothered to reinitialize the disk.

Enter SUM II. I invoked its first level of disk recovery techniques on the disk, and 10 minutes later, the disk icon appeared on my Desktop after rebooting. I was pretty amazed by this, since even Jasmine's own disk utilities had failed to recognize the drive before. I quickly SCSI-chained another new disk drive onto the afflicted drive and copied everything over, with the full directory structure intact. Thanks, SUM II.

Like Nisus, though, SUM II is not really at the end of its development. There are still crashed disks that SUM II can't recover, and many ease-of-use improvements could be made to the interface.

AppleLink 5.0
One of my pet peeves, as I've mentioned before, is having to use DOS laptops on the road. Thankfully, Apple finally fixed that problem for some of us. Plenty of my colleagues have accused me of being a Mac snob, but that's really not the point. Just as they can't live without their favorite DOS, Unix, or OS/2 programs, not having access to a Macintosh on the road produces the same kind of frustration for me.

Although the Mac Finder and I are on intimate terms, I can make do with DOS on the road, especially if I spiff it up with a graphical user interface like Simple Win or DESQview. But all the spiffling in the world won't let my DOS laptops run my Macintosh software. And that's the rub.

As much as I like Nisus and SUM II, I could live without them on my DOS laptops. But the one piece of Mac software that I use every day and can't afford to be without isn't either of those programs. Nor is it Excel, or HyperCard, or Think Pascal, or even VersaTerm. Nope, the single piece of Mac software that I miss the most is AppleLink.

AppleLink is Apple's on-line system that's run by GE Online Computer Services (the same folks that run GEnie). AppleLink is also the name of Apple's software that accesses this system. Without AppleLink, I'd be a dead duck in the Mac community. It's Apple's official online organ for the dissemination of System software updates and untold utility goodies. It contains important forums for higher education, and it's where the Apple University Consortium schools gather electronically.

Since AppleLink is a graphically oriented application that extensively uses Mac QuickDraw and other Toolbox routines, it runs only on a Mac (and I don't see Apple doing a port to OS/2 Presentation Manager or Windows any time soon!). So, no matter how fancy or expensive a DOS laptop I've had at my disposal, I just couldn't use AppleLink on the road. I have been known to pester friends, colleagues, and even strangers in order to borrow their Macs for 15 minutes, just so I could check my AppleLink E-mail.

The AppleLink application began as pretty good stuff. But in keeping with my thesis on the refinement of the computer industry, it's been updated several times in the last few years. The most recent revision, dubbed AppleLink 5.0, fixes a lot of quirks.

First of all, Apple has made it MultiFinder-compatible, so you can now do file uploads and downloads in the background (thank you!). The company also made it more customizable, by adding a personal menu that you can use to create special usage commands. Not forgetting the user interface, Apple improved the way that windows move about and scroll, which again improves its use with MultiFinder. A built-in file compression/decompression utility has been added, as well as support for a larger number of modems. Finally, the way in which AppleLink interrogates the network and updates the display has been sped up.

None of these improvements is striking, but they all add to the program's value and extend its functionality. Like the changes made to SUM II and Nisus 2.02, these are refinements that the Mac software industry has become adept at over the past year.

Now It's Apple's Turn
By the time Nisus, SUM, and many other programs reach the peak of the technology development cycle, Apple should have been there for some time. It needs to set the pace and push the technology along with new operating systems and new machines to the next stage.

And when the time comes, Apple needs to help start the cycle over again, so that the reality of U.S. computer technology never becomes like the fiction that Time would have you believe is reality.
Why Experienced Computer Users Don’t Think Very Much About Modems

Our research shows that knowledgeable MIS managers, PC coordinators, and end users simply don’t want to think about modems at all.

Not exactly what modem makers relish hearing! But it’s hardly surprising that you want to save your thinking for bigger and more important things.

Modems are a lot like plumbing. As long as the data is flowing, they’re practically invisible. However, when something goes wrong, those little boxes are just washed with attention.

By then, you’ve lost data, time, money, and perhaps an opportunity. Both senders and receivers are dismayed and disarrayed.

Fortunately, there are simple ways to limit this aggravation. Our research suggests a few points to keep in mind.

The cost of the modem is not the modem’s cost.

The fixed price of the modem is relatively insignificant. Ongoing costs matter far more.

In the long run, for example, a high-speed modem can save you a small fortune on phone bills. More data sent in less time means less money to the phone company.

You can also save with more reliable and robust modems that communicate over a wide range of telephone line conditions.

Resending data costs both time and money. The less time you spend transmitting data, the more time you have to spend on your business.

Downtime and adaptation time can also cost you dearly.

Be sure to ask if the modems are compatible with their earlier generations. You don’t want to start with suppliers who regularly obsolesce their own products, or who don’t offer you an upgrade path.

Modem support can be a real hassle with the wrong vendor.

Setting up and installing your modem can affect both your budget and your sanity. Many manufacturers forget to make their modems easy to use!

This becomes expensive when you want to start up fast or need to support a large number of users.

Dip switches, on-line help screens, and easy-to-use manuals should be demanded. It also helps to have a quick-reference guide printed on the bottom of the case.

In sticky situations, it’s vital to have toll-free support and applications engineering.

Bottom line: The data must get through.

A bit of data traveling from your computer is converted by your modem and sent to your local telephone office.

From there, it is exposed to the vagaries of phone lines, various transmission media, and weather patterns.

They all conspire to corrupt your data and slow down your throughput.

All modems are not created equal; some are less sensitive to noise and have better error-correcting protocols.

Some are simply more robust and have better filters.

Modems are more than mere commodities — technology does count.

“When things go wrong, I want the supplier there.”

That’s when you need the right supplier on board. Look for one who gives fast turnaround time on repairs and adjustments, and who doesn’t vanish after the sale.

Look for a company with history and promise — one that’s here today and here tomorrow.

Not everyone needs the same modem.

The best way to keep modems from wasting your time and money is to buy them from a reliable supplier with a broad product line. Those with limited lines sometimes try to cram square pegs into round holes.

People with differing applications have differing requirements. Dealing with a broad-line supplier simplifies ordering, reduces training/support time and cost, and limits hassle and coordination.

In the end, if you give enough consideration to choosing the right supplier, you’ll hardly have to give modems any thought at all.

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Is OS/2 really difficult for developers to use?

I recently received an interesting letter from Steve Mastrianni of Windsor, Connecticut. He's unhappy with the comments in my September 1989 column about OS/2 as an easy development platform. I've got limited space, so I hope Steve will forgive me if I paraphrase his main points. He says:

- There's no support for multithreaded applications under Code View for OS/2.
- Writing the simplest Presentation Manager (PM) program involves pages and pages of code.
- The documentation for the programming hooks (application programmer interfaces, or APIs) is awful.
- Device drivers are much harder to write under OS/2 than they were under DOS.

I'm surprised that Steve claims there's no debugging support in Code View for multithreaded applications. That certainly was true with early versions of Code View, but it has supported multithreading for almost a year. And if you want an extremely powerful OS/2 debugger, run, don't walk, to your nearest computer store for Logitech's MultiScope, which makes debugging a real snap.

A Page and a Half of HELLOs

Steve charges that the code to put a PM window on the screen is difficult. I'd first ask, "Who says you have to?" Remember that the PM relates to OS/2 the way Windows relates to DOS: You can choose to write programs that use the graphical interface, or you can choose not to. In the column he mentioned, I talked to three developers. Only one of them had written a PM application. His point about window complexity is well taken, but it's the same thing if you write a Windows application under DOS. With the PM, you have the added benefit that the operating system is a protected-mode system. Thus, program crashes don't always have to mean system crashes, as they often do under DOS.

Also, since the subject was raised, I'd like to see people stop beating up on PM and Windows development. Yes, writing Windows or PM applications is not trivial. A common argument against such programming is something like, "It takes a page and a half of code to write HELLO under Windows." (HELLO, for the nontechies, is the simplest program conceivable: It just puts "hello, world" on the screen and exits.) Yes, writing HELLO under Windows takes a page and a half of code—but who wants HELLO? I want to talk about doing real work. In today's world, HELLO is not even a meaningful program example, because it just spits output in a teletypewriter fashion to the screen.

For those who have trouble envisioning this, I'll give a simple example. A typical program listing for HELLO looks something like the following:

Begin Program HELLO
Print "hello, world."
End

That's not in any real-world programming language, by the way. Think of big-selling real-world DOS or OS/2 applications like Lotus 1-2-3, WordPerfect, or PC Paintbrush. All three control every aspect of the screen for the entirety of their session: Not once in the code of any of these programs does the program just squirt a message out to the screen. Every message must be properly placed on the screen, and all information currently on the screen must be managed when it is affected by new information.

Illustration: John Breakey © 1990
realistic HELLO would have to look like the following:

Begin Program HELLO  
retain the current information on  
the screen somewhere in memory  
clear a portion of the screen for a  
window  
set the default colors  
place the cursor  
print "hello, world.  
wait for the user's input  
close up the window and restore  
the screen information  
End

Doesn't that look like it might take up  
a few pages of code all by itself?  
Windows/PM programs get that automatically,  
as well as letting you place or resize windows,  
reduce programs to icons, or move to another application without closing the current application.

So, of course, Windows/PM applications take a bit more to get started: The minimum ante is higher and more realistic. But start building big applications, and you see that Windows code can be smaller (and easier to write) than non-Windows code for the simple reason that Windows does more for you. The problem with Windows programming is that it has a very steep learning curve. But once you're there, you can crank out programs quickly.

How do I know? I used to complain about Windows programming, but then I sat down and took the time to learn how to do Windows/PM code. It's a pain until you get over the hump, however. And there is a major problem with running Windows in the first place.

No matter what you do in Windows, you constantly run up against memory constraints. Install all the expanded memory you like, but it doesn't matter: It's always conventional memory that you're out of. That's why the PM is such an improvement — there is no more "insufficient memory to display dialog box" and the like.

Furthermore, if you're a programmer, you could do a lot worse than learn to write Windows/PM code. It's the way the world is going: Once you've learned the basic paradigms of Windows/PM coding, it's much easier to move over to the Macintosh or to Unix's X Window System. Most of my full-time programmer friends are doing at least a little Windows programming, and they all seem to think that it's something they'll have to do sooner or later. "It's either that or maintain somebody else's old COBOL payroll programs," seems to be the consensus.

Programming Documentation
Yes, the original Microsoft/IBM OS/2 documentation stank. The documentation with the first pile of OS/2 1.0 code was fairly complete but badly organized. Worse yet, the then-new APIs for the PM were documented only in an on-line documentation system called QuickHelp. QuickHelp is a nice reminder about programming minutiae, but (because you couldn't print out the entirety of the QuickHelp library) using it as a primary reference document made PM programming kind of like playing Zork. I think most of us ended up starting our code from examples of PM programming published in magazines and modified from there, passing bits of trivia to each other via BIX or the like.

That's all changed now. The PM Softset has been around for months, and the stuff shipped with the Softset is a great improvement. Documentation on the APIs is written out now, and, while it would be nice to see examples of how to use these things, the books stand as a fairly compact reference.

Finally, you should remember that OS/2 is more fully documented than DOS: There are not many undocumented system features, unlike the TSR-related functions that exist under DOS and that Microsoft uses in its own code but won't explain to the rest of us.

Devices Driving Him Crazy
I can't argue with Steve's contention that device drivers are in a class all their own when it comes to difficulty. You do not have the protection that you ordinarily do, and debugging OS/2 device drivers is, as far as I can see, a nightmare, although I must confess that I've never written one.

I have written a couple of DOS device drivers, however, and if OS/2 device drivers are truly as difficult to write as people say (Steve is not the only one to voice this complaint), he's got my sympathy. What's the answer here? Hardware debuggers, I suppose, although I don't know of any for OS/2.

If the PM Is So Smart, Why Don't We Have Applications?
Finally, he asked, "If it's so easy to write OS/2 applications, why aren't more available?" Good question. I've written in past columns about the number of OS/2 applications, and I argued in the IBM Special Edition (Fall 1989) that the number of OS/2 applications isn't that out of line with DOS's experience in its early months. Furthermore, the OS/2
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application lineup isn't bad at this point, featuring such heavy hitters as Lotus 1-2-3, WordPerfect, PageMaker, and every database you can shake a stick at. But some big negatives still exist, so I'll take up the question again.

As I see it, the forces still slowing OS/2 development are lukewarm support of OS/2 developers from Microsoft, cost, market uncertainty, and continuing lack of device support.

The first problem seems to be a rather half-hearted commitment to developers on Microsoft's part. The poor turkeys who shelled out $3000 for the Software Development Kit have been left out in the cold as OS/2 1.2 goes. Microsoft isn't sending them a copy of version 1.2, much less documentation on the new API calls.

This is incredible in my view. These are the people who supported OS/2 from the beginning! Microsoft has said that when it offers the version 1.2 upgrade to owners of the version 1.1 toolkit, it will offer Software Development Kit owners the upgrade for the same low price. No date has been announced for the version 1.2 toolkit. This is a good halfway measure, but what good is having version 1.2 if no one can build products for it? (How many of the OS/2 2.0 Software Development Kits does Microsoft expect to sell?)

Despite the fact that OS/2 development costs about the same today as DOS development cost in 1982, 4 to 8 megabytes of RAM for a workstation looks like a lot of memory. Some companies are getting cold feet about OS/2 acceptance. I talk to many developers: Virtually all of them are surprised that OS/2 is taking as long as it is to be accepted, and that has dampened some enthusiasm. Now that many of the big applications are out for OS/2, however, I expect that will change. Except for a giant, gaping hole: Where are the printer drivers?

We're still waiting for a PostScript driver that doesn't leak. And it was just recently that Hewlett-Packard and Microsoft finally agreed about who's going to write the LaserJet drivers and buckled down to work. Nobody has even fuzzy shipment dates yet. So we still live in interesting times.

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
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The Taxman adds it up

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Dealing with Devices

Some of our readers' more technical questions and problems

dealing with the devices that are attached to a Unix computer is often more complex than working with the machine itself. Linking a device to a new name is one shortcut that may help. But printers are another matter. Some printers are connected directly to the computer and should use the Unix print spooler. Others, connected to terminals, can be handled differently. This month, I'll go into these two issues and that of upgrading 80286 Xenix software for an 80386 system.

Floppy Disk Drives

Pete Johnson of New London, New Hampshire, wants to know if there's any shorthand available for disk names. My guess is that Pete, like lots of other people, is getting tired of typing things like /dev/dsk/fd096ds15 when all he's trying to do is talk to his floppy disk drive.

First of all, typing all that is often unnecessary. On many systems, there already is a shorthand filename linked to a floppy disk entry under the /dev directory. Look around your system with a command such as ls -l /dev/*fd*; if you're on a vanilla AT&T-based Unix system of recent vintage, you might need a command such as ls -l /dev/dsk/*, because such a system has the disk-oriented devices moved to its own subdirectory. In either case, you are likely to find an entry such as /dev/fd or /dev/fd0. This entry will probably be linked to a longer name, such as /dev/fd096ds15, which means it can be used interchangeably with the longer name. Links let you call a file by more than one equivalent name, and this is a perfect application for links.

How do you know which name is linked? Look for a match in major and minor node numbers (see listing 1).

If you want an even easier way to refer to your drive, Pete suggests taking a page from the DOS manual: The name /dev/A: would be nice. If it's your system, give it a try.

First, you should understand the nomenclature that is generally used to identify floppy disk drives on most Unix-based personal computers. The name /dev/fd096ds15 refers to the first floppy disk drive (numbered from 0) using high-density recording of 96 tracks per inch (96), double-sided (ds), with 15 sectors per track (15). This is a 1.2-megabyte floppy disk. Other systems may refer to it as /dev/dsk/f0q15d, for quad density, 15 sectors, double-sided. The naming scheme for 5-inch high-density would be /dev/dsk/f05h. Similarly, /dev/fd048ds9 is the first floppy disk drive, in 48-track-per-inch mode, double-sided, with nine sectors per track. This corresponds to a regular 360K-byte disk. On some systems, you can also read and write to older single-sided and lower-density disks by accessing the appropriate entries in the /dev directory.

If your system doesn't have a simple /dev/fd entry, it can probably still accept at least the name /dev/fd096 (or something similar) for drive A in high-density mode and /dev/fd048 in low-density mode. But say you want to use the idea of naming it /dev/A:.

First, check to see if there are any files that you might wipe out while installing this new name:

```
$ ls /dev/*A:* /dev/*B:*
```

In this case, it is a good sign if no files are listed by the ls command: It means that you don't have any conflicts with your planned device name. (It is also continued
always good practice to use ls with whatever wild card you plan to use with rm before removing the files. This way, you will see which files will be removed; they might not be the ones you had in mind.

To switch to superuser mode and make the links, type the following:

```bash
$ su
Password: [Enter]
# cd /dev
# ln /dev/fd096dsl5 A:
# ln /dev/fd048ds9 Alo:
# exit

(If you have a /dev/dsk directory, you should cd to that directory.) Your high-density drive can now be accessed using the simple name /dev/A; the same drive in low-density format can be accessed as /dev/Alo: If you have a second drive, you can use /dev/B: and /dev/Blo:, as well. If you don’t like these names, pick any you want; leave off the trailing colon, or whatever you like. It’s your system!

Printing at Home and Abroad
Rita Naudts of Antwerp, Belgium, has two questions that other readers may share. The first involves printers. Specifically, how do you configure centralized printing on Xenix?

I’m glad she specifies Xenix, because Xenix does have a way to perform what can be considered “distributed” printing from terminals. It is assumed that multiple users and multiple printers may be involved. On Unix, print spooler administration can be so complex that even people with their own home systems are often afraid to tinker with it—preferring instead to run only default spooler operations (for instance, printing unnecessary report headers even though there’s only one user on the system), or even giving up entirely by running all their print jobs in the background directly to the printing device, bypassing the spooler entirely, like this:

```bash
$ cat filename > /dev/lp
```

While I do sympathize, running the spooler isn’t all that hard; it’s just installing it that is complex. I will be glad to cover the subject in a future column if reader mail warrants, but the point here is that the print spooler can be considered “centralized” printing, even though it is possible to configure “local” or “remote” printers through the spooler. Distributed printing, as I see it, is the situation where people have their own local printers at their remote terminals, and they control them, not some spooler system sitting in /usr/spool/lp or anywhere else!

Many Xenix releases have for some time had (although not always documented) a program called lprint, which works with a local printer that is connected to a terminal. What the lprint program does is something like this:

1. Lock the terminal keyboard so accidental user input won’t interfere.
2. Put the terminal into “transparent print” mode, so that everything sent to the terminal is piped directly to the auxiliary terminal port without appearing on the screen.
3. Take the file(s) appearing on the command line, or standard input, and simply send them to the user’s terminal. Since the terminal is now in transparent print mode, the files will be printed if there is a local printer connected.
4. Take the terminal back out of transparent print mode.
5. Unlock the keyboard.

Step 3 is simply a fancy version of cat file > /dev/tty, but what about the other four steps? They’re done by sending the correct escape sequences to the terminal to put it into the desired mode, such as “keyboard locked,” “transparent print off,” and so on. These sequences can be found in your terminal manual and are generated with a simple C or shell program. (Hint: Look at the options for the echo command to see how to get “unprintable” escape sequences to go to your terminal.)

Once you understand the concept, it’s easy to write your own lprint command equivalent. And that’s why I’m not going to provide one here—if you aren’t sure what I’m talking about, you will learn a lot more by experimenting with using echo to generate escape sequences than you will by typing in some program I cooked up. If you do know what I’m talking about, you have only about 5 minutes’ work ahead of you, anyway.

In any case, the Xenix version of lprint does a few extra things, such as reading the /etc/termcap database using the curses library to determine the proper escape sequences for your terminal. This can be done by a C programmer with access to curses or by a clever combination of shell scripts and an awk program.

Upgrading to an 80386
The second question from Rita Naudts involves upgrading 80286-based Xenix software to run on an 80386 system.

This is a judgment call that depends on the type of software involved: applications, development, or operating system. Let me add that the principles are the same whether you’re talking about Xenix, Unix, or even DOS software.
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#### S Systems 10 MHz XT

<table>
<thead>
<tr>
<th>Item</th>
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<tr>
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<td>TEAC 288 floppy drive</td>
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<td>Multi I/O/13, 15, 16, 36, 38, 40</td>
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#### Monochrome Monitors

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#### Printers

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#### Math Co-processors

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<td>Symantac Q&amp;A 3.0</td>
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#### Mice

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<td>Logitech Bus Mouse</td>
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<td>Microsoft Mice</td>
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#### Modems

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#### Laptop Computers

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<td>Toshiba 1600-20</td>
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<td>Murata 1600</td>
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Since the 80386 CPU is upwardly compatible with the 80286 CPU, an 80386 will run any software written for the 80286 (or 8086 or 8088, for that matter) without change, although the software will generally run faster. Some DOS software, such as games, and older peripherals designed for a slower chip might be adversely affected, but I haven't yet heard of any kind of Unix or Xenix software that has such problems.

Needless to say, software written especially to take advantage of the 80386 architecture should run more efficiently on an 80386 than the same software written for the 80286 and run on an 80386. However, for most applications, this efficiency gain will be so slight that most users will probably not find it cost-effective to upgrade their software to 80386-specific code.

There are a few exceptions, of course. If you're a software developer, you might want to work with the latest C compiler, so your code can be recompiled for the 80386, if necessary. On the other hand, compiling for the 80286 gives you a greater potential market because of the upward compatibility mentioned above. Like everything else, there's a trade-off involved.

Operating-system software gets slightly more complicated. Say you're running SCO Xenix 286 on an IBM AT, and you trade it in for a new 80386-based machine. Can you now run the 80286 Xenix and applications on your 80386? Assuming your software and license wasn't traded in with your hardware, the answer is yes. If you are satisfied with the 80286 software and its capabilities, you can certainly run it on your 80386, and you will enjoy the higher performance of the new machine as well.

If, however, you want to take full advantage of the 80386 architecture, or run DOS as a task under Unix, or run the latest software under Unix System V release 3.2 or even 4.0, you're going to have to upgrade to an 80386-based operating system. But you can still run your old 80286 applications, because Unix System V releases 3.2 and 4.0 are themselves backward-compatible with your 80286 Xenix applications.

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Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
may be if I had seen the big orange Virginia Power truck pull up in front, I'd have been ready, but I wasn't. Instead, I had that old familiar sinking feeling as the power company started their line replacement program by turning my power off for 5 eternal minutes. The reason it seemed eternal was that the power went off while I was saving my December BYTE column to the hard disk. I hadn't backed anything up since I got a new Zenith Z-386 with a 150-megabyte hard disk drive.

**The Biggies**

One problem with the current trend toward high-capacity hard disk drives is that previous backup strategies no longer make sense. Where a box of floppy disks was once sufficient to support your backup requirements, now it would take a case of them. More important, it would also take someone (meaning you) to sit there and insert and remove floppy disks at the prompting of the software.

People are avoiding backups more than ever because the task has become impossible to manage. For today's hard disk drives, floppy disk backups are clearly yesterday's technology. Something better is needed so that people will perform backups, and it must be good enough to be a safe repository for the company's data.

For that "something better" to be useful, it needs to be more than just safe. It needs to lend itself to working the same way that people actually use their computers. That is, the backup medium should be able to hold all the data. You don't want to kill 25 minutes waiting to swap tapes.

The software should be easy to use, requiring nothing beyond the most minimal of training. Once started, operation should run unattended. You don't want to hang around to tell the software what to do, any more than you want to change tapes.

Backup should be fast enough that it can be performed while you're away at lunch or in a meeting, and the machinery should be quiet enough that it won't interfere with office routine. Automatic operation should be possible for those who don't want to get involved in the process beyond the point of inserting the medium and typing a command.

Of course, in companies that have LANs, an easy way is to back up all data to the LAN. Then the LAN management crew backs up your information while it's backing up the LAN. I'll look at LAN backup another time.

Another method that's growing in popularity is tape. That's right, the medium of the past is back in a new, compact, quiet, and easy-to-use form, and it may be the best all-around backup technique available. I've looked at three tape systems designed to support either a LAN or a workstation with a large hard disk drive: the Irwin Magnetics Model 2120, the Mountain Computer FileSafe TD-8000, and the Emerald Systems Rapid Recover Series 9000. Rather than worry about benchmarking the drives for speed or gross capacity, I looked for ease of use and setup and the flexibility to work in a variety of organizations.

**A Look at the Drives**

The Irwin Magnetics 2120 and Mountain Computer FileSafe are reasonably similar. They are designed to fit into a 3½- or 5¼-inch drive bay, and they can receive data from a dedicated controller card or from a floppy disk drive controller. They continued
plenty of tape drives have cartridges in the 40- to 60-megabyte range. These work fine, but they require you to swap tapes during the backup—a task that’s sure to discourage the process. These are large enough to back up the data that I currently have, although if I were to perform an image backup of the Priam, I’d need a larger tape.

Difficulty in installation can be another discouraging factor. Fortunately, the three drives I looked at excelled in this area. Installation was just a matter of putting the tape drive in the drive bay, inserting the controller card, and attaching the cables. The Rapid Recover was delivered in a cabinet, so it was even easier to install.

None of the tape drives required setting any switches away from the defaults. All supported parameter setting through software so that if it didn’t work the first time, changes were easy. None of the installations took over 10 minutes.

The ease of installation for these three tape drives was matched by their ease of use. The software that controls the backup for all three drives was logical in design and intuitive to use. I found the manuals to be almost unnecessary.

In addition to menu screens that let you choose what files to back up and restore, all three programs let you enter a command string to control the backup. This means that you can use a batch file to control the operation of the tape drive so that you can make backups completely automatic.

There were a few differences among the three drives. The Irwin Magnetics 2120 was the noisiest and slowest, but that’s not to say that it was objectionably noisy or slow. It was able to back up 50 megabytes of data on the Z-386 in about 19 minutes. The Mountain Computer FileSafe accomplished the same task more quietly in about 15 minutes, while the Rapid Recover was the quietest and did the backup in about 12 minutes. Each one was fast enough to accomplish its task in the average lunch hour.

Despite its size, I prefer the Rapid Recover, primarily because of its exceptionally good Windows-based software. I only needed to consult the manuals after using the drive to make sure that I wasn’t missing anything. The Rapid Recover Series 9000 drive, because of its speed, its silence, and its excellent software, is a superb backup device.

Actually, all three of these tape drives are excellent choices for backing up a workstation with a large hard disk drive. They meet the basic criteria that most business users care about: They are easy to use, they are fast enough that backups are likely to be accomplished, and they work well.

Both the FileSafe and Rapid Recover support complete backup of a Novell file server. This means that all the files will be copied, as will the system files, bindery information, and user rights data. The Irwin 2120 will back up the files on a server, but there’s no indication of support for backing up Novell-specific files.

Other Ways

There are, of course, other ways to make sure that your data is backed up and protected. You can, for example, use an optical disk, either as a WORM (write once, read many times) drive or as a rewritable optical drive. Both types keep their disks in a cartridge that can be stored away from the computer. They are quick and easy ways to back up, although the optical drives are often times more expensive than the tape drives considered here. In some cases, the idea of backing up to the file server may well work, especially if you have an employee who is assigned to this sort of task. Then you can make sure that the work is done. It’s even better if the file server is a VAX or some similar machine that is routinely backed up on a daily basis.

Justification

The main reason that users don’t back up their hard disk drives is that they don’t have the time. The second reason (not counting procrastination) is that it costs too much to get a tape drive.

However, the software provided with the three drives I’ve discussed lets them perform their function during the night, during lunch, or otherwise without supervision. And cost really can’t be an issue. All you have to do is figure out how much it would cost to reconfigure or replace all the data that’s on your hard disk drive, plus the money you would lose by not having the information, and you’ll see that a tape backup unit is cheap insurance.

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as “waynerash,” or in the to.wane conference.

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Novell's NetWare products connect many disparate systems, but the pieces don't always fit together perfectly.

People frequently think of Novell's NetWare as a single PC LAN product, but it's actually a family of products that have a common set of protocols. Naturally, they're supposed to work well together—which they do, as long as your LAN is all IBM PCs and compatibles. When you add Macs or VAXes, however, things aren't quite so simple.

The major problem here is version skew. Newer products, such as NetWare for Macintosh and NetWare 386, aren't in sync with the older ones. Both lack some of the capabilities of their NetWare predecessors and add some new features. Novell can, should, and probably will fix these problems, but until it does, you might be surprised when you try to mix these products in a single LAN.

The only way to avoid unpleasant surprises is to be aware of the problems that await you. Before we can talk about the problems of linking the various pieces, however, we have to look at the pieces themselves.

The Servers

At the low end of Novell's PC LAN scheme is NetWare ELS (Entry Level System), which comes in four- and eight-user versions ($695 and $1895, respectively). ELS actually lets you run such small LANs without a server.

Novell's bread-and-butter product, however, is Advanced NetWare/286 ($3295). You buy one copy of Advanced NetWare/286 per server, which can work with as many clients as the network will bear. You can also have many Advanced NetWare servers on a single LAN.

While most Advanced NetWare LANs run with a dedicated server, you can actually use the product without one. You still have to designate a PC as the server, but that system is available for other tasks as well. Of course, Advanced NetWare consumes a large amount of memory and processing power, so that server machine is probably not useful for any other large tasks. Most LANs need a dedicated server.

The next step up is SFT (System Fault Tolerant) NetWare 286. SFT adds to Advanced NetWare some features designed to protect its data disks. SFT supports multiple disk drive controllers, disk mirroring, and uninterruptible power supplies. It also includes the Transaction Tracking System, which is designed to improve the reliability of database operations. While SFT obviously has many desirable features, at $4995 it's expensive enough that you should be very sure that you need those features.

The new cornerstone of the NetWare PC family is NetWare 386, which Novell has designed to take advantage of the 80386's built-in multitasking and memory management features. NetWare 386 offers all the fault-tolerant features of SFT, as well as more power and a much more modular design than its predecessors. In particular, NetWare 386 has cleaner and better-defined interfaces between its drivers, protocol stacks, and server applications than any previous NetWare product. These clean interfaces make NetWare 386 a better platform for running different protocol stacks and applications than the earlier 80286-based NetWare products.

If you want even more server power, you can turn to a Digital Equipment Corp. VAX, courtesy of NetWare VMS. NetWare VMS makes a VAX running DEC's VMS operating system look like any other NetWare server. Its price...
varies depending on the size of your VAX. NetWare VMS lacks some of the flexibility of the PC server products: Those servers can work with such different network technologies as Ethernet, Token Ring, ARCnet, and StarLAN, while NetWare VMS currently can run only over Ethernet.

The Clients
A single NetWare client program lets DOS-based PCs work with any of these servers. But such PCs are no longer the only NetWare clients.

OS/2-based PCs, for example, can now work with any NetWare server via NetWare Requester for OS/2 1.1. This product is a key part of Novell's if-you-can't-beat-'em-join-'em OS/2 strategy, because it lets current NetWare users add OS/2 PCs to their LANs without having to move to an OS/2 LAN.

Another new client is Apple's Macintosh. The Mac is a much more difficult platform for NetWare than OS/2 is, because there are existing Mac protocol stacks and file-system protocols. (See "Breaking Down the Barriers," October 1989 BYTE.) NetWare for Macintosh includes both Mac client software and software that lets a NetWare server work with the existing Mac networking protocols and file system.

Novell's troubles with supporting Macs were obvious in NetWare for Macintosh's first release, which had many bugs and anemic performance. Novell has since delivered a new version (1.1; $200 per site) that fixes most of the early bugs and dramatically improves performance. Version 1.1 also includes some utilities that give Mac users access to most server maintenance functions.

Piece Offerings
It's clear how all these pieces should work together. Any client can access any server, or any number of servers, to which it is directly or indirectly attached. DOS and OS/2 PC clients can sit alongside Mac clients, all getting files and print services from any combination of Advanced NetWare/286, SFT, NetWare 386, or VAX servers. Just one big happy family, right?

Not quite. Most of the problems center on Mac clients. Novell implemented the server portion of NetWare for Macintosh as NetWare Value Added Processes. VAPs run fine on Advanced and SFT NetWare, but not on NetWare 386, which uses a new format, NLM (NetWare Loadable Modules), for its add-on programs. This difference is potentially significant for PC clients as well, because most NetWare add-ons, not just NetWare for Macintosh, are implemented as VAPs and won't work with NetWare 386.

Fortunately, many Mac NetWare users have a way around this problem: NetWare for Macintosh doesn't need to be on all your LAN's NetWare servers, just on the one to which you've attached your Macs. The Macs can use that server as a "gateway" to a NetWare 386 server. We have both an 80386 running NetWare 386 and an SFT server with NetWare for Macintosh, and our Macs can get to both servers via the SFT server.

The one catch here is that this plan works only with servers running NetWare 2.15 or higher (NetWare 386 is technically version 3.0), because NetWare didn't support the Mac file system before version 2.15. This problem crops up when you try to link Mac clients to a continued
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VAX server. Novell based NetWare VMS on NetWare 2.0, so Macs can’t access it—even when connected to a NetWare 2.15 server.

NetWare for Macintosh has also fallen behind Apple’s own networking products: It doesn’t support the newer AppleTalk Phase 2 protocols.

The Problems Within
So far, we’ve acted as though the only problems with NetWare are in the connections between the products and not in the products themselves. While we like NetWare, we certainly don’t think that it’s anywhere near perfect. Far from it.

At the low end, for example, we think that NetWare ELS just isn’t as good as some of the other entry-level LAN operating systems, such as CBIS’s NetworkOS and Artisoft’s LANtastic. ELS is both more difficult to install and harder to maintain than those products.

ELS is also a bad choice when you need to add users. To go from the fourth user to the fifth, you have to shell out the money to upgrade to the eight-user version. Worse, if you need a ninth user, you have to abandon ELS entirely and move up to the more complicated Advanced NetWare.

NetWare has traditionally been a bear to install. The process can take many hours. NetWare 386 goes a long way toward simplifying this task; in many cases, you can set up a NetWare 386 server in less than an hour. But NetWare 386 doesn’t yet work with Mac clients, and it costs a hefty $7995.

NetWare VMS also has several rough edges. Perhaps the biggest drawback is that it works only with RMS fixed-length-record VMS files. There are many other popular RMS file types, including delimited and indexed sequential, that you just can’t share via NetWare VMS. Also, the performance of NetWare VMS is currently nowhere near what it should be. Right now these limitations make this product interesting primarily to existing NetWare users who have VAXes that they must tie into their NetWare LANs.

In the Future
Novell is clearly having some problems bringing all its existing products in line. While we have no doubt that the firm is planning to do so as quickly as possible, the future may make that task even harder.

In the next year, vendors such as Data General, Interactive Systems, NCR, and Prime plan to release NetWare server products for their Unix and minicomputer systems. These versions are all based on Novell’s Portable NetWare, a reimplementation of NetWare designed to be easy to migrate to new systems. You can expect to see some of these products around the time this issue of BYTE hits the stands.

Of course, these new products will add still more pieces to the NetWare puzzle. We hope that Novell will take the time not only to fix the existing problems, but also to make sure that the new versions work seamlessly with the existing ones.
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  w/Zero Wait States Delivering up to 58.7 MHz
  Effective Throughput
• Intel 82385-33 Cache Processor with 32K 25NS
  Static RAM Standard, Field Upgradable to 64K
• 1024K RAM Standard Expandable to 16MB
• FCC Class "A", Intended for business use
• High performance 16bit VGA Cards on all VGA
  systems w/1024 x768 capability
• 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
• 1:1 Interleaving Dual Hard Drive/Floppy Drive
  Controller, 977.6 KB/SEC Caching Controller
  w/ESDI Configurations
• Enhanced 101-key AT Style Keyboard
• High Capacity 200 Watt System Power Supply
• Real Time Clock/Calendar with 5 Year Battery
• 80387 or Weitek Co-Processor support
• Phoenix BIOS with Full MS/DOS, OS/2, XENIX,
  UNIX, NOVEL, 3COM compatible
• 8 Slot motherboard design
• Full size case with 5 Disk Drive bays

Options:
• Full size Tower @ Case (shown above)
• Custom configurations w/Name Brand
  peripherals of your choice
• Factory Ram Upgrades

Simply put... We couldn't have said it any better ourselves!
Portables with More Power than Desktops.

Backlit CGA/Monographic LCDs from $1745
VGA Gas Plasmas from $2595

"THE VGA PORTABLE III IS EXTREMELY FLEXIBLE... ...more [disc] drive capacity than most portables...and the bang-for-the-buck ratio is very high, excellent high powered performance."

-PC Magazine: Over 20 pounds, over 20Mhz portables December 12, 1989

512K (286) or 1024K (386) RAM
Serial, Parallel, and Game Ports
1.2MB or 144MB Floppy, 86-Keyboard

The power, reliability and performance of our desktop system motherboards combine with our portable casing to make our systems technically unique!

We support 3 built-in, externally accessible disk drives, enabling dual (3.5" and 5.25") floppys for total media compatibility. Including tape CD-ROM drives or other devices to deliver desktop functionality in a Portable Unit.

Simultaneous internal AND external monitor support, VGA functionality, 2open card slots and our unique 3 drive support, permit this family to be used as a complete "in the office system" which you can pick up and take anywhere.

VGA Gas Plasma Portables

<table>
<thead>
<tr>
<th>Drives</th>
<th>286/12</th>
<th>286/20</th>
<th>286/286</th>
<th>386/16</th>
<th>386/20</th>
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<td>Floppy</td>
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LCD Backlit Portables

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<td>$4010</td>
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</tbody>
</table>

Standard System Features:
- All performance and compatibility features as in desktop models featured on previous pages
- 3 Accessible Drive Bays for 2 5.25" & 1 3.5" Units
- 2 Available Peripheral Card Slots
- 16 Grey Scale 640x480 VGA Plasma or 4 Grey Scale 640x400 CGA/Mono Graphics Backlit SuperTwist LCD Display
- Simultaneous internal and external displays
- 200Watt Auto Voltage Switching Power Supply

Actual VGA PLASMA Screen Image
**Monitors**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnavox</td>
<td>CMB962 13&quot; RGB Color</td>
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<tr>
<td>Mitsubishi</td>
<td>1381 14&quot; Diamond Scan VGA/EGA</td>
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</tr>
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<td>NEC</td>
<td>Multisync GS-2A 14&quot; Multi Mono</td>
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</tr>
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<td>NEC</td>
<td>Multisync 2A 14&quot; VGA</td>
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</tr>
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<td>NEC</td>
<td>Multisync 3D 14&quot; VGA/EGA</td>
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<tr>
<td>NEC</td>
<td>Multisync 4D 15&quot; VGA/EGA</td>
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<tr>
<td>NEC</td>
<td>Multisync 5D 20&quot; VGA/EGA</td>
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<td>C1391 Panasync 14&quot; VGA/EGA</td>
<td>$480</td>
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<td>Max 15 14&quot; Multiref. Mono</td>
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<td>UltraSync 16&quot; VGA/EGA</td>
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<td>Multiview 15&quot; Full Page w/slapover</td>
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<td>9915 14&quot; VGA</td>
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**Disk Drives**

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<td>Seagate</td>
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<td>$619</td>
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**Modems**

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<tr>
<th>Brand</th>
<th>Model</th>
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<td>ATI</td>
<td>2400ITC Internal Modem w/MPN5</td>
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<td>Hayes</td>
<td>2400ITC External Modem w/MPN5</td>
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<td>US Robotics</td>
<td>Courier HST 14,400</td>
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**Printers**

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<tr>
<td>Brother</td>
<td>HL-60 Laser (W), HPGL Editor's Choice</td>
<td>$1875</td>
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<tr>
<td>Canon</td>
<td>BJC-55 Wide Cartridge, 360dpi, QUIET!</td>
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<tr>
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<td>FX90 330/RR/FP</td>
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<tr>
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<td>Deskjet Plus</td>
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<td>Okidata</td>
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**Video Cards**

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<td>ATI</td>
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<td>NEC</td>
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**Networking**

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<tr>
<td>Novell</td>
<td>4 User ELS 265 Level 1</td>
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<td>NEC</td>
<td>Advanced Network 280 (Ver. 2.15)</td>
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**Software**

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<td>Aldus Pageworker</td>
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<td>Lotus 123 3.0 (DOES/OS2)</td>
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<tr>
<td>Microsoft Excel 2.1</td>
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<tr>
<td>Quandtdeck Desqview</td>
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<td>WordPerfect 5.1</td>
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<tr>
<td>Xenova Ventura Publisher 2.0</td>
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**Tape Backups**

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<td>40/60MB Colorado Memory Internal QIC-40</td>
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<td>60MB Archive Int. or Ext. w/Cont.</td>
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<tr>
<td>60MB Maynard Maystream Portable</td>
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<tr>
<td>150MB Archive Internal/External</td>
<td>$925/1250</td>
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<tr>
<td>150MB Maynard Maystream Portable</td>
<td>$1395</td>
<td></td>
</tr>
<tr>
<td>2.5GB Maynard Maystream Portable</td>
<td>$450</td>
<td></td>
</tr>
</tbody>
</table>

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PC Brand, Inc. 954 W Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri. 8am to 6pm Central Time. MasterCard, Visa, Discover, Checks and Approved P.O.S. are accepted. Prices and specifications subject to change.

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**FEBRUARY 1990 • BY T E 147**
Sophisticated graphics and file linking add new depth to spreadsheets

Steve Apiki, Stanford Diehl, and Howard Eglowstein

Remember VisiCalc? If not, you may not appreciate how far spreadsheets have come in the last few years. The newest crop can handle vast amounts of data and generate graphics that rival the best charting packages.

The BYTE Lab examined 15 of these data munchers, all of which can handle data in three dimensions; they run under MS-DOS or OS/2 or on the Macintosh. All 15 products allow you to include multiple layers of standard spreadsheets, either by linking sheets together or by providing a "cube" of data. Data needs room, so we wanted products that handle more than 640K bytes of RAM; under MS-DOS, this means supporting either extended or expanded memory. Finally, we wanted to see an integrated charting capability. Table 1 lists the functions that each spreadsheet supports, and table 2 compares the spreadsheets' features.

Of the improvements, the most obvious is the ability to connect multiple layers. If you think of a spreadsheet as the electronic equivalent of a ledger sheet, think of these packages as big blocks of ledger sheets. Even better, you can have any sheet access data from any other sheet without messing up your desk. And while advanced spreadsheets are much the same, they have their differences. Spreadsheets are classified as linking, three-dimensional, or relational, depending on the consolidation method that they use.

Linking spreadsheets are fundamentally the same as standard sheets. While a normal cell reference might be B11, a linking spreadsheet allows you to preface the cell with the name of another sheet in memory or on disk. PAYROLL: B11 might be the reference you enter in a budget sheet to use a value from the payroll sheet.

A 3-D product takes this one step further. B11 is essentially a reference to the second row, eleventh column of a flat sheet. 3:B11 might be a 3-D reference to that same cell, three layers deep. The advantage over linked sheets is that all the data can be in one structure, making it somewhat easier to manipulate.

A last category is the relational spreadsheet, which assigns data to fields, much as a database does. These are essentially hybrid products that are better suited to data management than straight number crunching. For that reason, we did not include any here. Examples of relational products include Javelin Plus from Javelin Software and TM/1 from Siaper Corp.

Performance Measures

High-end spreadsheets are used for heavyweight applications; they're often critical. We benchmarked DOS and OS/2 packages on a Compaq 386/20 with 6 megabytes of memory, and Macintosh software on a Mac Iici with 4 megabytes of memory. The results are graphed in figures 1 through 3. All the test sheets forced DOS packages into expanded (CEMM emulated) or extended memory.

The Mathmix test recalculates a worksheet of 128 rows by 128 columns. The sheet is organized into 64 columns of small blocks alternated with 64 blank columns; each cell is the result of a basic math operation (addition, subtraction, multiplication, or division) applied to the first two cells in its column. The result reflects speed in basic operations. Since spreadsheets are sometimes called upon to perform database functions, our second test is a one-key sort of a 7000-row by 5-column table.

Three tests based on the familiar Savage charting formula measure performance with floating-point operations and deeply nested formulas. The first, Load Savage, times the loading of a 320-row by 100-column Savage spreadsheet from disk.

Last test measures the time to recalculate the entire spreadsheet. Recalc Linked or 3-D times the recalculation of five 80-row by 80-column linked worksheets or a single 40-row by 40-column by 20-page 3-D sheet, whichever the tested package could complete faster.

Performance Measures

Welcome to the Real World

We also wanted to see how these products fared in a real environment. We made up a sample business, a pet store chain, and had each of the spreadsheet products compute the regional sales figures for four sales regions. Each region was on a separate sheet and used typical spreadsheet features.

A fifth sheet consolidated the data into a national summary. Either linking or the 3-D feature was used to extract results from the regional sheets. We found out that the spreadsheets differed not only in the way that they consolidated sheets, but in the ease with which the user negotiated such a task. True 3-D sheets make adding across sheets as simple as summing a column or row. Others link with a couple of clicks of the mouse. Some, however, require a truly awkward continued
Table 1: Extensive function support is important if you have a very complex or very unusual application.

<table>
<thead>
<tr>
<th>NUMBER OF SUPPORTED FUNCTIONS BY TYPE</th>
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<tbody>
<tr>
<td>Date/time</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td><strong>DOS and OS/2 products</strong></td>
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<tr>
<td>Excel for OS/2</td>
</tr>
<tr>
<td>Windows 2.10</td>
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<tr>
<td>Lotus 1-2-3 rel. 3.0</td>
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<tr>
<td>Lucid 3-D 2.2</td>
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<td>PlanPerfect 5.0</td>
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<tr>
<td>ProCube 1.03</td>
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<tr>
<td>Quattro Pro 1.0</td>
</tr>
<tr>
<td>SmartWare Spreadsheet 1.0</td>
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<tr>
<td>SuperCalc 5</td>
</tr>
<tr>
<td>20/20 version 2.33.11</td>
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<tr>
<td>Twin Level III 3.03</td>
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<tr>
<td><strong>Macintosh products</strong></td>
</tr>
<tr>
<td>Excel 2.20</td>
</tr>
<tr>
<td>Full Impact 1.1</td>
</tr>
<tr>
<td>WingZ 1.1</td>
</tr>
</tbody>
</table>

EXCEL

Excel has the distinction of being the only product in our review to run under all three of our test environments; DOS, OS/2, and Macintosh. Windows and Presentation Manager (PM) give the PC products an interface almost identical to that of the Mac.

More important, the files are fully transportable among the three versions. Our output test was first assembled in the DOS/Windows version, read in by the OS/2/PM version, and then finally copied to the Macintosh via the Mac’s SuperDrive. The only hitch was with the linked files—the Mac’s operating system wasn’t happy with the naming convention from the PC. A couple of clicks with the mouse, and it was fixed.

The mouse interface is a natural for spreadsheets—not so much for data entry, but for editing data, it’s great. Mac users may already know this, but PC users may be in for a pleasant surprise. And if Excel is your first introduction to Windows or PM, the added ability to cut and paste spreadsheet data and graphs to other applications is certainly a big advantage.

One fly in the ointment is Excel’s inability to combine charts and spreadsheets. Assembling a combined page with both graphics and text requires some other program. We used PageMaker 3.0. Word processors under the
different operating systems can probably do as well.

All three versions of Excel worked identically. Excel takes some getting used to, especially if you’re new to PC

graphics environments.

On our benchmarks, Excel placed in the low middle of the pack. The Mac and OS/2 versions undoubtedly benefit from their environments’ better memory han-

dling. Overall, we found Excel to be an adequate performer. Anyone who needs to port data across different PC operating environments may want to check this spreadsheet out.

FULL IMPACT

Ashston-Tate’s product record has been hit-or-miss lately. Full Impact (for the Macintosh) is one product that often gets overlooked for all the wrong reasons. That’s too bad, because it’s nifty. It did a terrific job with our pet store project and turned in excellent times on all our benchmarks—all, that is, except the sort test, where the 7000 rows of test data wouldn’t load.

Full Impact’s limit is 2048 rows for any one sheet.

The biggest surprise may be the clean interface and ease with which you can manipulate charts once they’re drawn. If data-based presentations are your specialty, Full Impact has a good selection of charts and graphics primitives.

Full Impact is more limited than WingZ, but in a way that makes it more useful. Unlike WingZ, Full Impact’s graphics primitives are easy to find and easy to control. After all, you buy a spreadsheet primarily to manipulate data, not graphics.

Linking spreadsheets together takes simply a click or two in the right place. The kicker here is Full Impact’s requirement that you load all your sheets into memory—and you can’t open more than eight at a time. Both Excel and WingZ are limited only by the amount of free RAM.

The array of icons on the screen was a little busier than we’d like—better than some applications, worse than others. We wouldn’t mind if some of the functions were moved to pull-down menus.

Full Impact should please all but users with the largest worksheets. We think Full Impact is a hit.

LOTUS 1-2-3 3.0

Since Lotus released the latest version of 1-2-3 a few months ago, most of the criticism has been leveled at its performance. While release 3.0 is certainly a step down from the lightning reflexes of its predecessor, 2.01, our tests show that, on the proper hardware, 3.0 more than holds its own against other high-end packages.

That hardware remark is not made casually. Release 3.0 won’t even run on a PC with less than an 80286, and it requires at least 1 megabyte of memory under DOS. However, 3.0’s use of extended DOS memory certainly brightened its benchmarks in comparison to the expanded-memory packages.

Release 3.0’s 3-D implementation is the best of those of the packages that we reviewed. It combines the convenience of a pure 3-D spreadsheet, where pages behave just like rows and columns, with the flexibility of multiple file linking. You can load many files at once, and each file may or may not consist of multiple sheets.

Range commands and formulas work with 3-D selections just as you’d expect them to; when you move a block of data, you can move it up, across, and deeper into the spreadsheet, and all relative formulas remain intact. If you’re familiar with earlier versions of 1-2-3, you’ll find the transition to three dimensions easy.

The only 3-D weak spot in 3.0 is the rigid window structure, which limits you to a fixed view of three partial windows.

Enhancements to 3-D also improve 3.0’s database capabilities. Multiple sheets and multiply linked files allow you to create a true relational database inside 1-2-3, and extended database functions give you full access to them. Lotus’s DataLens database interface offers potential access to a host of external databases, but as of this writing, users remain limited to the dBASE III driver provided with 3.0.

While graphs have been improved in 3.0, 1-2-3 still has disappointing report presentation. Fonts are limited to those of your printer, and there is no capability for adding special effects such as shading and outline boxes.
Table 2: A spreadsheet comparison summary. Although many packages share advanced features, we found that good implementations of features set a few apart from the crowd.

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Minimum system</th>
<th>Network aware</th>
<th>Expanded memory</th>
<th>Maximum sheet size (cells)</th>
<th>Recalc. features</th>
<th>Consolidation type</th>
<th>Files in memory</th>
<th>Files on-screen</th>
<th>Link to disk file</th>
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</thead>
<tbody>
<tr>
<td><strong>DOS and OS/2 products</strong></td>
<td></td>
<td></td>
<td></td>
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1 B=background, M=minimal. 2 S=standard (bar, line, pie); E=enhanced, 3=3-D. 3 Extended memory. N/A=not applicable.

Lucid 3-D 2.2 offers a TSR interface, mouse support, and a convenient notepad feature.

Lucid 3-D (for DOS machines) stacks up surprisingly well for a $99.95 spreadsheet. It's fast, it supports a mouse, and it delivers some features you might not expect.

As a TSR program, it sits on top of your application, passing data through a clipboard file. From Lucid's menu bar, you can Grab data from an underlying application or Dump spreadsheet data into it. We listed a text file at the DOS prompt, called Lucid with a hot-key se-
sequence, selected the Grab option, and captured the listed data by a click and drag of the mouse. Better still, you can paste spreadsheet data to the clipboard and pass it to a word processor or database. It's as easy as a Mac, and it worked flawlessly with WordPerfect and the Norton Editor. Lucid manages all this with a character-based interface, so it can't run on top of Windows.

Lucid lets you open up to nine windows at once, and you can switch among them using the Alt key combined with a window number. You can link an entire sheet to one cell to create a hierarchical approach with embedded files, or you can link in the traditional way by adding an external file reference to a cell. Lucid does not allow multiple file references in a single cell, though. Also, the interface seems intrusive once you get down to serious work, but a host of shortcut keys solves that problem.

Lucid's notepad feature makes spreadsheet annotations simple and effective. The notepad has its own menu and can also pass data through the clipboard to the spreadsheet or underlying applications. Lucid has an adequate set of functions, but if you need more, you can easily define them yourself.

We ran into an unusual problem that kept us from running the Recalc Linked Savage benchmark. On attempting to update the links, Lucid searched for nonexistent files and aborted. (DacEasy says it is working on a fix that should be complete by the time you read this.) Lucid also lacked 3-D graphs and allowed us to save only one graph with each spreadsheet.
**PRODUCT FOCUS**

**THIRD-GENERATION SPREADSHEETS**

### MATHMIX AND SORT BENCHMARKS

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**Figure 1:** (a) Our Mathmix benchmark measures performance with common arithmetic operations. SmartWare Spreadsheet was outstanding; SuperCalc and ProQube were disappointing. (b) The effectiveness of sorting functions varied widely. Lotus 1-2-3 release 3.0 and Excel for OS/2 were the strongest performers.

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**PLANPERFECT**

If you’re a WordPerfect user, PlanPerfect (for PCs) should appeal to you. It offers the same function-key interface and an easy way to dump spreadsheets into a WordPerfect file. PlanPerfect also provides pull-down menus and the familiar Lotus command structure. One way or another, you should be able to find your way around.

Once you’ve settled on an interface, the program is fairly easy to use. It has a few nice perks, including page preview and table generation. PlanPerfect easily handled our what-if table from the menu.
Build a multi-user, 85K, dBASE compatible application using pulldown menus, popup windows, and data entry from pick lists.

**Portable**
When you are done, port your application to Unix, Microsoft Windows and OS/2 without modifying a single line of code.
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As you become an expert Code Base 4 user, you will find yourself examining the source code as you read about the internal operating principles of Code Base 4.
Enjoy the benefits of complete dBASE functionality, including data entry, windows, menus, multiple index files per database, dBASE expression evaluation, fields, filters, relations, reindexing, and editing.

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Figure 2: (a) Load test. (b) Savage Recalc test. (c) Savage Recalc test using linked or 3-D sheets. WingZ and 1-2-3 shared top honors on all these tests. PlanPerfect ran a modified version of the Savage test that fit in memory but downgraded performance; 20/20’s requirement that linked sheets be saved and reloaded contributed to a poor showing on the Recalc Linked test.

PlanPerfect's major shortcoming is its linking capability. First, you can load only two sheets into memory. Although you can still link cells to files on disk, you lose speed and versatility. Normally, you could display an overview worksheet and, when you need more detailed data, hot-key between the subsidiary sheets. You cannot have more than one file reference in a linked cell, and, worst of all, the link is not dynamically refreshed. You must first save your source file to disk; then you can either display a list of links and hit a function key, or you can save the destination file and reload it (all links are refreshed when a file is loaded).

WordPerfect users should consider the package just for the interface, but, with Quattro Pro available for the same price, you'll be sacrificing some serious power.

continued
After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell. Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

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Circle 154 on Reader Service Card
Figure 3: (a) Short Recalc test. (b) Long Recalc test. WingZ blazed through both of these Recalc tests, while 1-2-3 showed effective minimal recalculation with sharp contrast between the two tests.

ProQube 1.03 has true three-dimensional capability, including alternate data views.

ProQube stands out with true 3-D operation at a price under $100. When you open a “workqube,” you have immediate access to as many as 512 spreadsheet pages. The PC’s PageUp and PageDown keys step you through the pages. To draw data into a consolidation page, you simply add the cell references. You can also do a sum through the layers.

ProQube’s 3-D interface also includes an interesting view function. Menu options let you look at your spreadsheet from many different angles. From the standard front view, our project included
column headings for three different years, with “numbers of pets sold” for row entries. Each page covers a different region. A right view shows sales for each region, with each page covering a different year. A top view lists the pets sold as column heads and each year as a row. Each page then covers a type of pet. The menu bar lists six different view angles.

The menu bar also grants access to a slick file manager. The left side of the screen displays a menu tree of your default drive. You can select directories by arrow keys or the mouse. The right side of the screen lists the files within the selected directory. Function keys can then load a spreadsheet file or even trigger standard DOS file operations, such as copy and delete.

ProQube falls short in a couple of areas. It handles a maximum of only 512 rows. It would not run our large Savage benchmark because the test included more than 7000 chained cell references, and what it could run, it ran slowly. The company says that a new version of ProQube will include new algorithms without these limitations. Perhaps a worse problem was that the graphs were not presentation quality.

QUATTRO PRO

While Lotus has divided its users into two different camps, Borland offers one spreadsheet for all DOS users. Borland employs a proprietary memory management scheme to swap unused code segments to disk, thus offering a high-end spreadsheet to low-end machines. Those users will have to accept some performance trade-offs, of course.

Quattro Pro is a joy to use. Its mouse support extends beyond simple pointing. The interface includes scroll bars and a user-programmable mouse palette for negotiating keys such as Escape and Enter without resorting to the keyboard. Once you’ve used a mouse for spreadsheet manipulation, you may never want to go back to your arrow keys. Borland includes a Lotus-style interface and Quattro’s own interface. If you don’t like either of those, you can define your own. Yet even with a custom interface defined, you can still run Lotus macros directly. You also have the option of switching from a character-based interface to a true graphical interface with icons and other aesthetic perks. You can open up to 32 windows under Quattro Pro and then link files by pointing and clicking. It lacks true 3-D capability, however.

Quattro Pro easily negotiated our pet store project, producing the kind of output you might expect from a Mac. Pull-down menus led us through the database and what-if tasks. A few clicks of the mouse built the graph, and a couple more clicks placed it in the file. Quattro offers a wide assortment of fonts and typefaces. A full-page preview gives you a look at the output before you print it.

The graphing module has been improved. Not only can you embed a graph into your spreadsheet, but you can also change your data and see the changes immediately. Lotus 1-2-3 release 3.0 makes it easier to view “live” updates, but it doesn’t let you place the graphs into your worksheet.

Quattro Pro also lets you embellish your graphs with advanced drawing features. You can then save the graph as an Encapsulated PostScript file for output to PageMaker or other EPS-format programs. You can also easily link data into your graph from a different spreadsheet or many different spreadsheets. Borland has covered all the bases and should have a big winner with Quattro Pro.

SMARTWARE SPREADSHEET

SmartWare Spreadsheet 1.0 boasts exceptional performance and some impressive features, such as support for up to 50 windows.
little effort. You just include an external file reference and cell reference. Enclosing row or column numbers in brackets marks them as an absolute reference. Multiple file references can be combined into a single-cell formula. SmartWare's linking suffers from one glaring weakness: It won't link to files on disk. Each referenced file must be loaded to an open window. If you open a spreadsheet with linked references and fail to load the referenced sheets into memory, SmartWare retains the latest numbers. A simple recalculation, though, triggers an error.

Although SmartWare includes some powerful matrix features, including regression, we had to type in multiple formulas to generate our what-if table.

The graphing module produces some very nice output, including 3-D graphs. You can add or modify legends, titles, colors, fonts, and other attributes from a graph definition screen. The graphs are regenerated only on command.

**SUPERCALC 5**

Computer Associates' SuperCalc 5 (for PCs) offers many of the same capabilities as 1-2-3 release 3.0, but a few features have key differences. Your opinion of SuperCalc 5 will depend primarily on how you weigh the relative importance of three factors: performance, 3-D capability, and report presentation.

Speed is not SuperCalc's strong suit. Our benchmarks put SuperCalc 5 consistently near the back of the pack, except on the Savage benchmarks. Performance was especially disappointing on the Mathmix test.

SuperCalc offers true 3-D sheets as well as interfile linking, but the 3-D implementation is not quite as sharp as 1-2-3's or ProQube's. SuperCalc's pages are not treated exactly like rows or columns; interpage references are always absolute. If you copy a range on page 2 that references pages 1 through 3, the block will continue to reference page 1, not page 2, as you might expect.

If good graphs and stylish reports are more important than speed or seamless 3-D, however, SuperCalc has your application covered. The package offers an extensive range of graphs, from mundane bars to high-low graphs and polar charts. You can create combination graphs or add 3-D perspective.

Text layout options allow for shading and border special effects. You can also select fonts and point sizes (if your printer supports them) of up to 20 points.

Other features, including database management, are similar to those of 1-2-3 release 3.0. Data commands aren't as 3-D as they are in 1-2-3 (e.g., there's no equivalent of a three-variable what-if).

**20/20**

The 20/20 spreadsheet on the PC is a port of a popular spreadsheet for the VAX/VMS environment. Access Technology sells the PC version primarily as an adjunct to sales of its product for larger systems. It may not be quite as snazzy as 1-2-3 or Quattro Pro, but it offers solid functionality and compatibility with a broad range of computing environments.

The usual complement of macro commands, functions, and graph support make for functionality comparable to 1-2-3's. But some features, especially linking and database management, are not as advanced as they are in the other packages that we looked at.

File linking is 20/20's weakest point. Only one file can reside in memory at a time, so all links must be to disk. In addition, links are hard-wired spreadsheet features that cannot be moved or copied conveniently. External references can't be used in formulas, although you have the option of applying one of several operations to the linked reference at link time. All links are resolved when the spreadsheet is loaded.

For software ported from a terminal environment, 20/20's graphics capability is surprisingly good. In addition to standard graphs, you can print and view scatter plots and mixed charts. Text output is limited to a single font, and no text special effects are supported.

On the plus side, 20/20 can exchange worksheets with its VMS, Unix, IBM mainframe, and other counterparts via a common data file format.
In this far from perfect world, not every surge-suppressing device gives you the protection you need from electrical power line distortions. The surges and "spikes" that can destroy or shorten the life of your high-tech equipment. That's why an AT&T Surge Suppressor is a low-cost investment in complete protection. Because only AT&T gives you solid-state architecture, AT&T Bell Laboratories engineering, UL-approved circuitry, and a thermal cut-off feature to disconnect power before it becomes hazardous. Plus the reliability assurance of the company with a century of experience in AC and telephone line protection. For the location of your nearest AT&T dealer, just call 1 800 638-7978.
**TWIN LEVEL III**

If Twin is still trying to keep pace with Lotus, it has lost a few steps. Level III (for PCs) is not release 3.0. Still, for $219, Twin packs a lot of features into the familiar Lotus interface. As with Lucid, Mosaic calls its product 3-D, although it really provides file linking, not true 3-D spreadsheets. A workgroup option lets you save all your related sheets in one quick operation, but you can’t slice through the worksheet to, for instance, sum cells across layers.

Twin uses a windowing scheme to load multiple spreadsheets into memory. Only RAM availability limits the number of windows you can open. You can hot-key to different windows or zoom into any one. Given these overlapping windows, you might think you could establish links by selecting a window and pointing to an external cell. Not so. You must first block off a range of cells and name the block. You then use the named range as an external reference. This gets cumbersome when you need to name multiple cells before linking them.

We had to create the what-if table manually, but the Twin database functions were well developed, including the creation of forms for data entry. The Twin documentation lets you see how far the product has come over the course of three releases, but it can be a pain to search three separate manuals for a topic.

The graphics are fairly rudimentary. There are plenty of graph types, and the program does an adequate job, but they can’t compare to the output of SuperCalc, Quattro Pro, or Excel on the PC.

Mosaic recently distributed a beta version of Twin for Windows (Twindows). It appears to be a notable product.

**WINGZ**

It’s hard not to like WingZ on the Macintosh. It’s fast, it handles insanely large spreadsheets, and it produces stunning graphs. It consistently outperformed most of the spreadsheets in our tests, regardless of operating environment.

If we dislike anything, it has to be the user interface. The learning curve on this product is steep—it will take most people a fair bit of time to become comfortable with WingZ. Of course, most people would also need time to learn how to fly an F-16 fighter, and WingZ is relatively as sophisticated.

There are a few things we’d like to see in future releases: We missed the search-and-replace function that Excel offers for modifying groups of formulas. A more intuitive graphics editor would be wonderful. Generating the data is easy, as WingZ’s interface is almost standard on a particular spreadsheet vendor, it may be best to stick with the latest offering from that vendor. While all the products include data conversions, it’s best not to rely too heavily on them. Ideally,
"Do you know what the underground bargain C compiler of this year is? It's the Mix Power C compiler. For under $25 with shipping, it is one heck of a good compiler."

Victor Schneider
Dr. Dobb's Journal, June 88 (Letter to the editor)

"Overall, Power C's performance is remarkable for the price. Quite compatible with the Microsoft C and Turbo C 'standards', Power C is a heavyweight contender in the educational, hobbyist, and perhaps even the professional market — at a bantamweight price."

Stephen Davis
PC Magazine, September 13, 88 (Review)

"Power C is an unbelievable product for $19.95, and is very competitive with Turbo C, Microsoft C, and Microsoft's new Quick C in both features and performance. It is excellent for the beginner who wants to learn C, or for the experienced programmer who wants to develop professional applications. The manual alone is worth the price of this package, and the generous library source code and assembler offer adds to the value of it. If you have any desire to program in C, or want a more powerful C compiler, get a copy of Power C!"

Michael Cortese
Computer Shopper, August 88 (Review)

"The Ctrace debugger is where Mix really shines. It is magnificent. It's not only better than the stripped down debugger Microsoft includes with Quick C, it's better than the full debugger Microsoft provides with its high-end compiler (Codeview)."

David Weinberger
Computer Shopper, November 88 (Review)
"Mary had a 4GL whose performance was very slow and everywhere that Mary went the run-times had to go."

Pro-C gives you the greatest gift in the computer world – time. You get high quality, fully commented, error free C source code in a fraction of the time it would take to write it by hand.

Pro-C has always saved you time and that saved you money. Now you save even more. Vestronix has dropped the price of Pro-C from $675 US to $399.00! And Pro-C Work Bench, the C source code libraries that let you quickly customize your application, is absolutely FREE! A great program at great savings.

Pro-C will increase your ability to create programs quickly by generating the source code for menus, reports, screens, windows, and multi-file batch updates. Textbook quality C code is written by us, while the elegant system solutions and exciting new algorithms are created by you.

Pro-C looks and feels like a 4GL, but it's not. You can do prototyping, layout, design and generation of applications without learning a proprietary language, needing massive amounts of memory, or ending up with slow running programs. Best of all Pro-C doesn't require any run-time licenses. Finally, a company that treats you like royalty instead of forcing you to pay them.

Pro-C – the programming partner that does the boring, repetitive coding without complaint, pays for itself every time you use it, and doesn't argue with your obviously brilliant program designs.

With PRO-C, everybody's a winner.
you can select a spreadsheet purely on its own merits—and here, we can offer a few suggestions.

On the PC, stick with those that are either 3-D or handle linking well. Quattro Pro and Excel have excellent linking capability. In particular, we like Lotus 1-2-3 for its speed and Excel for its ability to span Mac and PC operating systems. Lucid 3-D, at $99.95, was an unexpected find. While it's not another Lotus 1-2-3, it's easily worth the price. Finally, our hats are off to Quattro Pro—it's sure to be a feather in Borland's cap.

On that note, it should be no surprise that WingZ was our choice on the Mac. Full Impact ran a very close second, but WingZ finally won out because of its ability to handle larger spreadsheets, and more of them. And, while both had excellent graphics capabilities, WingZ is the obvious choice for putting glitz into a presentation.

These advanced spreadsheets resemble VisiCalc—the pioneer product—only in that they come on floppy disks. It's easy to confuse these products with databases, word processors, and desktop publishing packages. Numbers never looked so good.

Steve Apiki, Stanford Diehl, and Howard Eglowstein are testing editors for the BYTE Lab. They can be reached on BIX as “apiki,” “sdiehl,” and “heglowstein,” respectively.
The ViVa24 Modem knocks 'em dead with style and convenience.

Finally! An affordable, state-of-the-art modem designed to maximize any workstation or desktop and take up minimal space. The new 2400 baud modem from Computer Peripherals, Inc. is a 100% Hayes compatible external modem which boasts more high-tech features than its competition at an unbelievable price tag.

The compact, distinctively sleek tower design simplifies placement, and it's easily accessible, front panel power switch eliminates fumbling around the back of the unit. The handsome weighted base holds the ViVa24 firmly in place, and sharp LED indicator lights are aligned for comfortable viewing, utilizing international graphic icons that make the ViVa24 simple to understand.

The small tower design creates a natural flow of air over the surface of the board, allowing the ViVa24 to run cooler and affording you 24-hour, worry-free operation. The ViVa24 modem provides the user compatibility with IBM PC, XT, AT, IBM PS/2, Apple Macintosh computers and any computer that supports RS-232C.

The ViVa24 modem represents innovation from its footprint up with features such as: use of the Hayes "AT" command set, asynchronous data format, auto-dialing, auto answer, adaptive equalization, non-volatile memory, automatic tone and pulse dialing, remote access while your computer is unattended, self-test and built-in diagnostics. Best of all, the ViVa24 is fully backed with a five-year limited warranty.

Before investing in an ordinary modem, be sure to investigate the ViVa24.

Call your nearest dealer or call us for details.

Circle 61 on Reader Service Card (DEALERS: 62)
The Mac Portable's pluses outweigh its minuses

Don Crabb

The Macintosh Portable is Apple's long-awaited and much-delayed attempt to crack the lucrative portable computer market. Since its announcement, it has generated much criticism for its weight, size, and price. Nevertheless, the Portable has many pluses that make it worthy of consideration.

BYTE has already covered the technical aspects of the Portable and its slightly modified System software in the First Impression "The Portable and the Powerful" (October 1989). Therefore, I'll discuss system details only briefly and concentrate on my experiences with the machine.

A Quick Rundown

The Mac Portable includes a 68000 processor that runs at 15.67 MHz—twice the speed of the Mac SE. It comes with a single SuperDrive 1.44-megabyte floppy disk drive that reads Mac or PC disks, and 1 megabyte of 100-nanosecond static RAM for $5799. Adding a 40-megabyte internal SCSI hard disk drive brings the price up to $6499. A second floppy disk drive ($499) and an internal 2400-bps modem ($449) are also available, as is a second megabyte of SRAM ($649).

The Portable's active-matrix LCD screen has a wide viewing angle and is the sharpest display that I've seen on any portable computer. The backlit LCDs that I love on the Zenith SupersPort and TurbosPort portables seem crude and blurry by comparison. But the lack of a backlight on the Mac Portable means that you can't use the machine in a darkened airplane cabin or in other areas that are poorly lit.

The keyboard is pure Macintosh and works as well as the Apple Standard and Extended keyboards. It lacks a numeric keypad, but you can add one for $69. The arrow keys aren't well positioned; they sit at the lower right side of the keyboard, in keeping with the standard Mac SE keyboard.

The Portable includes the standard Macintosh connector ports, including two AppleTalk/serial ports, one SCSI port, and one Apple Desktop Bus port. Apple includes a low-power ADB mouse with the Portable, but none was ready in time for this review. The main pointing device is a built-in mini-trackball located on the keyboard. If you're a southpaw, you can switch the location of the keyboard and trackball in the keyboard chassis. But if you need the optional numeric keypad, you should plan on using the ADB mouse: The keypad replaces the trackball.

The Portable also includes special power management circuitry that can extract 8 or more hours of battery life out of its 6-volt lead-acid gel-cell battery. During my month of tests, I got at least 8 hours of battery life, even with heavy disk access. My best battery times were in the 10-hour range. You can recharge the Mac Portable's battery by plugging in its external power supply, or you can buy a separate charger ($99). Extra batteries are $35 each and are quite easy to install. The lead-acid battery adds 2 continued
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Macintosh Portable

Company
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Components
Processor: 15.67-MHz Motorola 68000
Memory: 1 megabyte of 100-nS static RAM, expandable to 2 megabytes
Mass storage: 1.44-megabyte 3½-inch floppy disk drive that reads several Apple and IBM PC formats
Display: Built-in flat-panel, active-matrix reflective LCD; 10-inch diagonal screen; 640 by 400 pixels
Keyboard: 63-key standard keyboard with built-in mini-trackball; numeric keypad option
I/O interfaces: ADB port (mini-DIN-4 connector); internal ADB port for mini-trackball; two RS-232C/RS-422 serial ports (mini-DIN-8 connector); internal 2400-bps modem connector; DB-25 SCSI connector; internal SCSI connector; stereo sound port; DB-19 external floppy disk drive port

Size
15¼ × 14½ × 4 inches (height tapers to 2¾ inches at front); 13¾ pounds (15¼ pounds with hard disk drive)

Options tested
40-megabyte 25-ms internal SCSI hard disk drive: $700

Price
Base system: $5799
System as reviewed: $6499

Inquiry 851.

pounds to the machine, but it lasts far longer than nickel-cadmium batteries and doesn't require the deep discharge that nickel-cadmium batteries need before recharging.

Apple bundles System 6.0.4, Finder 6.1, and MultiFinder 6.1 with the Portable. System 6.0.4 has a few unique features, such as a Portable cdev that controls the machine's power management circuitry. The Portable also comes with HyperCard 1.2.5 (made to work especially with the Portable) and the usual Macintosh printer drivers, system resources, and system utilities.

Road Test
My review unit included the hard disk drive, the SuperDrive, and 1 megabyte of RAM. It came packaged with a well-made and attractive carrying case that also holds a spare battery, the power supply, manuals, disks, and other computing desiderata. The carrying case has a padded round handle and an adjustable padded shoulder strap. It wasn't too much of a burden to carry the Portable around in airports, but if you're also carrying a briefcase, you'll want to strap the thing to a luggage cart.

The machine also came with a power supply, a setup guide, 10 software disks, six manuals, a Macintosh quick-reference card, and a set of luggage tags. The software includes three getting-started disks that will help Mac novices. Apple backs the machine with its usual pathetic 90-day limited warranty.

I carried the Mac Portable with me on several business trips (in airports, airplanes, rental cars, and hotels) over the course of a month, as well as toting it back and forth between my home and office. I accidentally dropped the machine more than once while it was operating; once I knocked it off my desk, and it fell 3 feet onto a carpeted floor. It never failed.

I also tested the machine's "sleep" mode, a low-power mode that kicks in automatically after several minutes of inactivity (the time interval is selectable). When you select sleep mode from the Desktop's Special menu, the Portable will shut down most subsystems after a few minutes, but it retains all your open applications in memory in their current states. Hit any key, and you're instantly back where you left off. This feature is slick and effective, but it's not new to portable computers.

The 25-millisecond hard disk drive was sufficiently fast, but 1 megabyte of RAM just doesn't cut it for everyday use. I use MultiFinder, and I like to keep several applications open simultaneously, especially the Nisus word processor and the VersaTerm Pro communications program. I can't fit both of these into a single megabyte of memory under MultiFinder. And you can forget about doing anything really meaningful with HyperCard 1.2.5 in 1 megabyte of RAM. So if you buy the Portable, shell out the extra dough for the SRAM upgrade; you'll need it. When SRAM upgrade cards become available, you should consider upgrading to 5 or 9 megabytes—if you can afford it. SRAM is expensive: An upgrade to 9 megabytes could cost as much as you will initially pay for the entire Portable.

While First Impression authors Tom...
### APPLICATION-LEVEL PERFORMANCE

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### LOW-LEVEL PERFORMANCE

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<tr>
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<th>VIDEO</th>
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<tr>
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<td>Graphics4</td>
<td>Dhrystone (Dhrystone)4</td>
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<tr>
<td>Word-wide</td>
<td>32 blocks</td>
<td>Slow test</td>
<td>Benchmark 1154:</td>
</tr>
<tr>
<td>Long word-wide</td>
<td>1 block</td>
<td>QuickDraw</td>
<td>Benchmark 2107:</td>
</tr>
<tr>
<td>Sieve</td>
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<td>1.30</td>
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<td>3.20</td>
<td>Benchmark 1154:</td>
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<tr>
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<td>Write</td>
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<td>Read</td>
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<td>Write</td>
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<td>0.20</td>
<td>4.40</td>
<td>Benchmark 1633:</td>
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### Notes

1. All times are in minutes:seconds. Indexes show relative performance; for all indexes, a Mac SE=1.
2. The Floating Point benchmarks use the SANE library.
3. Read and write times for File I/O are in seconds per 64K bytes.
4. The Slow test uses code written in Small-C to perform the circle draw and fill. The QuickDraw version uses QuickDraw commands to draw and fill the circle.
5. For the Dhrystone test only, higher numbers mean faster performance.

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*Cumulative application index. Graphs are based on indexes at left and show relative performance.

---

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.
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- Improved math co-processor support and emulation for faster highest-precision math operations with or without a co-processor.
- Improved alternate math library for faster math operations without a math co-processor.

Microsoft/QuickBASIC/Turbo Pascal

Benchmark Performance
BYTE's benchmark tests reveal that the Mac Portable is up to twice as fast as a standard Mac SE and has a much faster hard disk drive. What the benchmarks don't reveal is how these numbers relate to everyday use. The Portable simply feels much faster than it is.

The Portable compared favorably to the accelerated 8-megabyte color Mac II that I normally use. I almost never found myself wanting more speed for basic operations like file copying and deleting, PostScript page printing, or working with everyday documents using Nisus, Excel, Lightspeed Pascal, VersaTerm Pro, and HyperCard. Unlike the Mac SE that I've lugged with me on trips, the Portable's speed was more reminiscent of my Mac II's, although it falls short of my accelerated (25-MHz 68030) Mac SE's. Still, I was pleasantly surprised at how fast the Portable felt. The combination of a clear, fast screen, a 15.67-MHz CPU, some custom application-specific integrated circuits, and a fast hard disk drive all conspire to make the Portable a pleasant traveling companion.

Portable in Perspective
All this circuitry, the fancy display, the disk capacity, the full-size keyboard, and the trackball don't come without some negatives. Those negatives are price, size, and weight. The Mac Portable is expensive. You start at $5799; if you add a hard disk drive, a modem, and an extra megabyte of RAM, you're up to $7497. The machine is also large—definitely too big to fit comfortably on a lap or on a coach-class tray table. And it's heavy, at about 16 pounds for a hard disk drive unit.

The question for potential Portable buyers is whether the Portable's technology adds up to something worth buying, despite these negatives. The answer is yes. It performs well, and the Portable is one beautiful machine. The design, both inside and out, is truly a work of art. It's that impressive.

The Portable's nonbacklit screen doesn't handle lousy lighting conditions well, but it's the sharpest, clearest display you'll see on a portable computer. Its fancy power management circuitry and lead-acid battery help the Portable operate for long periods without external power.

Whether or not you buy a Mac Portable also depends on how important it is to you to remain in the Mac environment while you're on the road. On a cost basis, DOS-based portable computers are far better values. Many 80286-based machines run from $3000 to $5000. But if you need a Mac on the road, the choice is clear.

If you use a Mac at home or in the office, then having one on the road is worth the sacrifices you'll make to your sacroiliac (carrying the thing over your shoulder in its fancy carrying case), to your traveling lifestyle (you'll have to fly first class to get a tray table big enough to hold it), and to your wallet.

Sure, the Portable isn't perfect. It should have been lighter, smaller, and cheaper. Considering the time that it took for Apple to get it to market, it should have included more jazzy and innovative circuitry. But it's a real Macintosh. It doesn't require pulling the ROMs out of your Mac SE, like the Wallaby does. It's clearly superior to the Dyna-Mac and the Colby. And it's a heck of a lot easier to carry around than a Mac Plus or SE.

With the Macintosh Portable, you can get your Macintosh computing done on the road, and get it done in style and for hours on end. That's the bottom line that Apple shot for, and the company has succeeded admirably.

Don Crabb is the director of laboratories and a senior lecturer for the University of Chicago department of computer science. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."
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Zenith's MinisPort proves a roadworthy companion

Robert Mitchell

If the TurbosPort 386 is the Arnold Schwarzenegger of Zenith's portable computer line, then the MinisPort is its Baryshnikov. The notebook-size machine doesn't have the muscle of its 80386-based counterpart, but it's light on its feet and puts in a good performance for its size.

Driven by an 8-MHz Intel 80C88-2, the MinisPort offers all the amenities for light-duty computing in transit: small size and weight, a backlit LCD that rotates 180 degrees, 1 megabyte of RAM (384K bytes of which you can configure as a nonvolatile RAM disk), a 720K-byte 2-inch floppy disk drive, a slot for an internal 1200-bps modem, and DOS 3.3 and Rupp Corp.'s FastLynx LX file transfer program tucked neatly away in ROM. What's not small, however, is the price. $1999 gets you started; add a modem and an extra megabyte of memory (you'll need it), and the price goes up to $2998.

A Solid Model
The MinisPort feels and looks solid. The chassis won't twist in your hands, as those of some laptops do. The display's metal latches click firmly into place, and a metal carrying handle snaps out from under the front of the case. The keyboard is sturdy and responsive. Zenith backs the machine with a one-year parts and labor warranty.

The system has a clamshell design; the display opens up to reveal an 80-key keyboard. A set of LEDs sits just above the keyboard, and the sliding contrast and brightness controls are easily accessible just under the screen. On the left side of the case are slots for a tiny 1200-bps modem and the MinisPort's nickel-cadmium battery. Both devices slide easily in and out of the chassis. The battery cover has a cutout for the DC power input jack. The modem has a line jack, but (as on most laptops) it lacks a handset jack. A recessed power button and a 2-inch floppy disk drive sit in the right side of the machine.

The display is a 25-row by 80-column, blue supertwist reflective LCD with electroluminescent backlighting. The screen measures 9 inches diagonally (8 1/4 by 3 1/4 inches square) and supports CGA graphics with eight gray scales.

A hinged door on the MinisPort's back panel hides four I/O ports. In addition to standard parallel and serial ports, Zenith includes connectors for an external CGA monitor and a floppy disk drive. My test machine included an external 720K-byte 3 1/2-inch floppy disk drive. The drive measures a compact 7 1/4 by 4 1/2 by 1 1/4 inches and pulls its power from the MinisPort. Zenith also offers external 360K-byte 5 1/4-inch and 720K-byte 2-inch versions for $399 and $349, respectively.

Another storage option is to allocate extra memory as a silicon disk. My review machine included 2 megabytes of RAM—the maximum configuration. The MinisPort doesn't use RAM cards, as NEC's UltraLite does; instead, it has surface-mounted DRAMs on the motherboard. A memory upgrade requires returning the machine to the dealer.

Using Zenith's bundled MFM-180
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Zenith MinisPort

Company
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60026
(800) 553-0331

Components
Processor: 8-MHz 80C88-2, switchable to 4.77 MHz
Memory: 1 megabyte of 100-nsec surface-mounted DRAM chips (2 megabytes maximum); 832K bytes of ROM containing DOS 3.3 and FastLynx LX file transfer program
Mass storage: Internal 720K-byte 2-inch floppy disk drive; memory above 640K bytes is configurable as battery-backed RAM disk
I/O interfaces: 25-pin parallel port; 9-pin serial port; 9-pin external monitor connector; external floppy disk drive interface; internal 1200-bps modem slot; DC power adapter socket

Options tested
External 720K-byte 3½-inch floppy disk drive: $299
Internal 1200-bps Hayes-compatible modem: $199
Starter kit (10 2-inch floppy disks, FastLynx cable, slipcover): $139
1 megabyte of RAM: $800

Size
12½ x 9½ x 1¾ inches; 5½ pounds

Price
Base system: $1999
System as reviewed: $3436

Inquiry 852.

utility, you can assign RAM above 640K bytes as extended memory or as a RAM disk. MFM also lets you enable or disable the ports and set backlighting time-out to save battery life. (For a more in-depth description of the MinisPort, see "The Ever-Shrinking, Ever-Expanding Laptop," August 1989 BYTE.)

Field Test
When you first turn on the MinisPort, it boots from its ROM disk—drive C—which contains MS-DOS 3.3 and the FastLynx LX file transfer program. To set up the silicon disk, you press Ctrl-Alt-Ins and select Setup. The silicon disk becomes drive D. The floppy disk drive is drive A. Two nonrechargeable 3-volt lithium batteries back up the RAM disk when the main batteries run out; they sit in a small compartment on the underside of the case.

The next step is to run FastLynx to get your programs to drive D or drive A.

FastLynx installs itself on the host computer, and its menus make the program easy to use. But Zenith doesn't include the necessary cabling. You buy it as part of an optional starter kit, which includes a 6-foot, three-headed serial cable, a slipcover for the MinisPort, and 10 2-inch floppy disks.

The MinisPort's keyboard isn't full travel, and the numeric keypad is an overlay that you use with the Fn key. But the keys aren't jammed together as on some laptops, and the response is adequate for use on the road.

The display is less accommodating. The screen has a wide viewing angle, but it appears washed out and is hard to read under some lighting conditions. I found myself continually repositioning the screen and fiddling with the contrast and brightness controls as I used the machine. Like the NEC UltraLite, the MinisPort's squarish display distorts the aspect ratio.

It's too early to say whether the 2-inch floppy disk format will catch on, but its incompatibility with desktop systems is a disadvantage. FastLynx works fine for serial-port file transfers, but it's more convenient to pop a floppy disk out of your laptop and into your desktop system. At $99 for a box of 10, the disks are also expensive. The RAM disk is so much faster that I recommend buying the maximum RAM and working from the silicon disk as much as possible.

Zenith rates battery life at 3 hours, but your mileage may vary. If you use the modem or the external disk drive, battery life plummets. I got from 1½ to 3 hours between charges. If you use a word processor with the backlighting on, expect to get about 2½ hours of battery life. That makes the machine fine on, say, a New York-to-Washington flight. But for longer trips, you'll want to bring an extra battery ($79). An off-line battery charger ($109) is also handy.

When you get where you're going, you'll need the external power supply (a 2½ by 7½ by 1½-inch brick) and its 6-foot power cord. The MinisPort warns of a low battery by beeping intermittently and flashing the power indicator light. You then have 5 to 15 minutes to get to a power source or plug in a fresh battery before the machine shuts itself off. The battery takes about 3 hours to recharge.

Performance
Like the UltraLite, the MinisPort lacked the disk space to run the PageMaker and dBASE III Plus tests in BYTE's application benchmark suite. The MinisPort continued
### APPLICATION-LEVEL PERFORMANCE

**WORD PROCESSING**
- XyWrite III + 3.52
  - Medium/Large: 13/1:40
  - Word count: 13/1:40
  - Search/replace: 25/1:19
  - End of document: 13/1:40
  - Block move: 26/1:25
  - Spelling check: 42/5:40
- Microsoft Word 4.0
  - Forward delete: 1:36
- Aldus PageMaker 1.0a*
  - Index: 0.68

**SPREADSHEET**
- Lotus 1-2-3 2.01
  - Block copy: 19
  - Recalc: 0:8
  - Load Monte Carlo: N/A
  - Recalc Monte Carlo: N/A
  - Load large3: 17
  - Recalc large3: 0:6
  - Recalc Goal-seek: 20
- Microsoft Excel 2.0
  - Fill right: 29
  - Undo: 11:48
  - Recalc: 10
  - Load large3: 2:01
  - Recalc large3: 0:6

**DATABASE**
- dBASE III + 1.1*
  - Index: N/A

**SCIENTIFIC/ENGINEERING**
- AutoCAD 2.52*
  - STATA 1.5
    - Graphics: 5:01
    - ANOVA: 3:20
  - MathCAD 2.0
    - IPS 800 pts: 6:56
    - FFT/IFFT 1024 pts: 8:22

**COMPILERS**
- Microsoft C 5.0
  - XLisp compile: 16:26
- Turbo Pascal 4.0
  - Pascal S compile: 17

**LOW-LEVEL PERFORMANCE**

<table>
<thead>
<tr>
<th>CPU</th>
<th>Matrix</th>
<th>38.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>String Move</td>
<td>Byte-wide: 214.56</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Word-wide: 157.53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Odd-bnd.: 157.53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Even-bnd.: 157.53</td>
<td></td>
</tr>
<tr>
<td>Steve</td>
<td>166.81</td>
<td></td>
</tr>
<tr>
<td>Sort</td>
<td>136.69</td>
<td></td>
</tr>
</tbody>
</table>

**DISK I/O**
- Hard Seek3
  - Outer track: 0.42
  - Inner track: 0.44
  - Half platter: 0.46
  - Full platter: 0.46
  - Average: 0.45
- DOS Seek
  - 1-sector: 3.07
  - 32-sector: 18.74
- File I/O+
  - Seek: 0.67
  - Read: 0.54
  - Write: 0.61
  - 1-megabyte
    - Write: 4.47
    - Read: 3.27

**VIDEO**
- Text
  - Mode 0: 25.83
  - Mode 1: 25.85
- Graphics
  - CGA: Mode 4: 11.15
  - Mode 5: 11.13
  - Mode 6: 11.70
- EGA: Mode 13: N/A
  - Mode 14: N/A
  - Mode 15: N/A
  - Mode 16: N/A
- VGA: Mode 18: N/A
  - Mode 19: N/A
  - Hercules: N/A

**CONVENTIONAL BENCHMARKS**
- LINPACK: 13453.83
- Livermore Loops6
  - MFLOPS: 0.00
  - DFlops (MFLOPS): 692

**Notes**
- *Due to the MiniSport's limited disk space, we were unable to run every application test of the B YTE benchmarks. Tests using Aldus PageMaker, dBASE III Plus, and AutoCAD were omitted. We also omitted the results of those tests for the systems used for comparison and adjusted their cumulative application indexes accordingly.

---

For a full description of all the benchmarks, see "Introducing the New B YTE Benchmarks," June 1988 B YTE.
## Tandy’s WP-2: DOS, Shmos

**Ben Smith**

Before you shell out $3000 or more for a state-of-the-art notebook-size computer, consider this: Many people use their laptops for only basic word processing and telecommunications tasks. If that’s all you need on the road, think about Tandy’s $349 WP-2.

The WP-2 isn’t a DOS machine. It’s a portable word processor that includes a 100,000-word spelling checker, a 200,000-word thesaurus, and telecommunications functions. The WP-2 measures 8½ by 1 by 11¾ inches and weighs just over 3 pounds. It stores documents in RAM and runs for up to 12 hours on four AA alkaline batteries. A lithium battery maintains the RAM storage. An optional battery eliminator/charger is $6.95.

The machine comes with 32K bytes of RAM, 22K bytes of which is available for data storage—enough for about seven pages of single-spaced text. You can buy another 32K bytes of internal RAM ($49.95). There is a slot for removable 32K-byte external expansion cards ($119.95 each), which perform the functions of a floppy disk. You can connect a $219.95 Tandy hard disk drive through the 9-pin serial port, and there’s a parallel printer port and a port for connecting a cassette tape drive.

The display is an 8-row by 80-column nonbacklit yellow LCD that measures 8¾ by 1¾ inches. Tandy includes a 62-key QWERTY keyboard. The keys are set at a slight angle so that if you prop up the WP-2 on its fold-out feet, you have a keyboard with the same angle and feel as that of a desktop PC.

The word processor software is simple but complete. It uses two function keys (F1 and F2), combined with the top-row (number) keys, to invoke word processing operations: Find, Replace, Select (set block), Copy, Cut, Paste, and Insert/Overwrite. Function keys combined with alphabetic keys let you center, underline, boldface, and change the text font in which you print. (You enter the actual printer control strings in the printer setup screens.) Function keys and standard keys bring up the spelling checker and synonym finder.

Tandy gives a detailed setup for the standard AT 9-pin asynchronous serial port: direct connect/modem line monitoring, 75- to 9600-bps communications, and 5- and 8-bit communications, with a variety of other standard settings that include XON/XOFF and CR character remapping. You can download and upload files using either straight ASCII files (use the XON/XOFF in this case) or XMODEM file transfer communications. The dialer/modem control is easily configurable. However, you can’t set up your parameters from within the telecommunications operations without hanging up your modem connection.

The word processor includes two other standard extensions: an appointment list and a phone list/dialer. These appear to be afterthoughts. They’re severely limited and in no way integrated with the rest of the WP-2 operations. If you use the dialer to dial up a computer, you must exit the dialer, go to word processing, and then go into telecommunications. This process hangs up the modem, terminating your remote session before you even start. The appointment list doesn’t include a calendar, and there’s no real-time clock.

Besides the deficiencies in integration between the various operations, the Tandy WP-2 has two major flaws: It doesn’t support file transfers faster than 1200 bps, and it drops characters if the input is too fast. The first problem is probably a bug in the communications program. The second problem is most noticeable when you are communicating with a remote system, even when using XON/XOFF handshaking. Once the input buffer is full, it starts losing characters. Since the LCD scrolls very slowly, it isn’t immediately apparent what’s happening. File transfers go directly to memory without being echoed to the screen, so they don’t have this problem.

The WP-2 has similar problems in word processing. If you are even a moderately fast typist, you’ll discover that inserting text within a paragraph is visually very slow. It’s easy to fill the keyboard buffer, at which point the WP-2 ignores keystrokes until the buffer has space. The WP-2 beeps when the keyboard buffer is full.

The WP-2’s problems are all software-related, and updates are unlikely, since the ROMs are surface-mounted. But if you can work around these problems, you’ll find the machine easy to use, physically well designed, very light, and easy to tuck into the pocket of an attaché case or a large purse—and it’s refreshingly inexpensive.

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*Ben Smith is a BYTE technical editor. He can be contacted on BIX as *bensmith.*
also couldn’t run BYTE’s AutoCAD tests. For consistency, some adjustments were made to the cumulative application indexes of the machines used for comparison.

The MinisPort was substantially slower than the UltraLite overall (see “The Painlessly Portable PC,” August 1989 BYTE). The MinisPort’s CPU index of 0.40 is considerably slower than the 0.93 that the UltraLite’s 9.83-MHz V30 CPU attained. The UltraLite was also nearly twice as fast on the video tests and on most of the application-level tests. The MinisPort’s one saving grace was the silicon disk, which proved to be nearly twice as fast as the UltraLite’s in the low-level disk tests.

The Verdict

Compared with the UltraLite, the Zenith MinisPort is noticeably slower, slightly larger, and nearly 1½ pounds heavier. The UltraLite also has a bigger, better-quality display and includes a 2400-bps modem. But the MinisPort is much sturdier and has a superior keyboard and a longer battery life. The display is acceptable. And it includes a parallel port, which the UltraLite lacks (an optional external floppy disk drive does include a parallel port). Comparably equipped, the two machines are about the same price.

If you can live with a nonbacklit display, a smaller RAM disk, and a 4.77-MHz CPU, you can buy a Toshiba T1000 for less than half the price of the base model MinisPort. If all you do is basic word processing and telecommunications on the road, perhaps you don’t need an MS-DOS machine at all (see the text box “Tandy’s WP-2: DOS, Shmos” at left).

The biggest problem with the MinisPort is that newer machines may upstage it by the time you read this. Toshiba’s new T1000SE offers a similar base configuration with a standard 1.44-megabyte 3½-inch floppy disk drive for $1699. Compaq’s LTE is another strong alternative. It includes a 1.44-megabyte 3½-inch floppy disk drive and 640K bytes of RAM for $2395. Both machines weight about the same as the MinisPort and are about the same size (see “Laptops Forever,” December 1989 BYTE, for a first look at these machines). But you can’t go wrong with the MinisPort.

If you can afford it, it’s certainly worth a look.

Robert Mitchell is a BYTE technical editor. He can be contacted on BIX as “rob_mitchell.”
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The downsized LaserJet IIP brings affordable laser printing to the desktop

Alan Joch

Leading the vanguard of affordable laser printers, Hewlett-Packard's LaserJet IIP realizes an elusive dream: putting 300-dot-per-inch print quality and a range of fonts on the desktop at a realistic price.

The $1495 IIP, with a standard 512K bytes of memory and no accessories, was selling for $950 from some mail-order companies at press time. Because of the reputation and installed base of the IIP's ancestors, notably the LaserJet Series II, the smaller cousin by default provides a standard with which to compare downsized laser printers. In that role, the 4-page-per-minute, 300-dpi IIP performs admirably, as long as you're a laser-printer user with time on your hands. If not, you may be inclined to believe the P in IIP stands for "pokey."

Better to Be Seen, Not Heard

Aesthetically, the IIP may be HP's most pleasing design. The cube measures only 13½ by 8½ inches and stands 16 inches high (see figure 1). But even more important for a printer meant to sit at your side day in and day out, the IIP is refreshingly quiet. It's rated at 44.1 decibels during printing. To my ears, it was louder than the fan on the BYTE Lab's 33-MHz 80386 PC, but quieter than the fan on the Macintosh II next to me.

HP conveniently grouped the six control-panel keys on the top of the printer. They're more like oversize keyboard keys than the squishy touch-sensitive buttons on the Series II, and they provide a pleasing click. A blinking black square in the nearby command window clearly shows when the printer pauses for data from the computer. (You can program command-window messages to appear in four other languages besides English, which is helpful for bilingual offices and HP's overseas marketing plans.)

Unfortunately, some menu items, including font selection, require you to hold down Alt while pressing a second command key. Even with the handy tear-out reference card that came with the manual, I needed time to learn the key combinations required for some menu selections. Also, because the keys and the command window sit on top of the unit, they're hard to read from a sitting position if the printer is on your desktop.

Those who place the printer on a lower credenza may not have this problem.

The printer's top also sports a shallow saucer that collects printed pages. Retractable paper stops in the saucer keep letter-, legal-, and A4-size pages in place. But the flimsy stops and the saucer are the two most obvious corners HP cut to design this lower-priced laser printer. I missed the Series II's deep, well-defined paper bin that holds printouts in tight, compact stacks.

I noticed the difference especially when I printed large text files. Paper in the IIP's saucer collected in messy piles, although the pages never clogged the exit. Paper in the top-exit path forms an inverted S as it travels through the printer (see figure 1). HP also includes an output tray that attaches to the front of the printer to collect media that travel in a C

continued
**Fitting**

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Cupertino, CA 95014
(800) 752-0900

**Size**
13½ x 8½ x 16 inches; 30 pounds

**Software Needed**
Applications that support HP PCL

**Documentation**
Quick Start guide and owner’s manual

**Price**
$1495

**Inquiry** 854.

Shape to a second face-up exit. The company recommends that envelopes, labels, and transparencies travel the latter path.

Also lightweight is the standard input paper tray. When not in use, it folds neatly into the front of the printer; when you’re ready to print, it swings open to a 75-degree angle. In the open position, the printer’s footprint increases by 10 inches. Usually, that extra space had already become home to manuscripts, file folders, and coffee cups, so before I could print anything, I first had to rearrange my desk to accommodate the paper tray. This seemed like a lot of trouble for a tray that holds a maximum of 50 sheets of paper. I preferred the optional $195 tray that attached to the printer’s underside; it held 250 pages and increased the unit’s height by only 2½ inches.

---

**LaserJet IIP**

**Company**
Hewlett-Packard Co.
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900

**Size**
13½ x 8½ x 16 inches; 30 pounds

**Software Needed**
Applications that support HP PCL

**Documentation**
Quick Start guide and owner’s manual

**Price**
$1495

**Inquiry** 854.

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**Font Selection**

Seven standard fonts reside in the printer’s ROM: six Courier typefaces in various sizes and styles, and an 8½-point line-printer font. The printer can produce each of these fonts in portrait (vertical) or landscape (horizontal) orientations. In addition, the IIP accepts HP’s LaserJet font cartridges. I tested two such cartridges, one with Times Roman fonts in both portrait and landscape orientations, and the second with Helvetica fonts in portrait only. Interestingly, when I told PageMaker to print a text file in landscape mode using the Helvetica cartridge, the IIP merged the landscape command with the proper font and then printed the text horizontally. The cartridge won’t allow this on the Series II.

---

**Figure 1:** The LaserJet IIP is designed to be a welcome guest on your desktop or credenza. Smaller than the LaserJet Series II, the IIP makes some trade-offs, primarily with its humble output trays, to accommodate downsizing. But the IIP balances its shortcomings with some added capabilities, including internal fonts that can be printed in portrait and landscape orientations. The IIP offers two paper paths and exit choices. The more complicated inverted-S path brings printouts to the top of the printer and stacks pages (face-down) in proper order. The C-shaped front exit is a must for envelopes and adhesive labels that wrinkle easily.
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This cartridge is also compatible with the HP II, HP IID and Canon© LBP 8II laser printers.

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- 9 point medium, bold, italic
- 10 point medium, bold, italic
- 11 pt medium, bold, italic
- 12 pt medium, bold, italic
- 14 med., bold, italic

Swiss type face in:
- 8 point medium, bold, italic
- 10 point medium, bold, italic
- 12 pt medium, bold, italic
- 14 med., bold, italic

24 pt bold

Prestige Elite in:
- 10 pt/12 pitch med., bold and italic
- 7 pt/9.66 pitch

Letter Gothic in:
- 12 pt/12 pitch med., bold, and italic

Presentation in:
- 14 point bold
- 18 point bold

Line Draw medium in:
- 10 pt/12 pitch
- 12 pt/12 pitch

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THE LASERJET IIP: INEXPENSIVE, NOT CHEAP

Page 1 of 300-dpi graphics. If you need full-page graphics, HP offers memory boards at $495 and $990 for 1 and 2 megabytes, respectively.

Head to Head
I tested speed and print quality with four test files that were run at least three times each on the IIP and a Series II. Two of these files consisted entirely of text generated from XyWrite III Plus 3.51. The first file was a single page of single-spaced text; the second, 15 single-spaced pages. I also designed a 1-page newsletter using Aldus PageMaker 3.0. It included a masthead with boldface and outline type, a 4½-inch-square line drawing, and 12½ column inches of text. Finally, I created two Harvard Graphics 2.1 pie charts on a single page, with a bold title and subtitle and no text other than chart labels (see figure 2). I chose 300-dpi resolution when printing the newsletter, and standard quality to print the pie charts. (The IIP's 512K-bytes of standard memory was enough to print the charts in high-quality mode, but the overburdened Series II was unable to do this. For consistency, therefore, I used standard quality for my time tests.)

As table 1 shows, the IIP lagged behind the Series II in all four tests. In some cases, such as the 14-second difference in the 1-page file, I could ignore the slower speed. But when that was multiplied over 15 pages, the difference rose to almost 2 minutes. Mixed text and graphics, as in my newsletter example, showed only moderate time differences.

The IIP's 300-dpi output exhibits the quality you'd expect from a laser printer. If you shuffle together printouts from the IIP and the Series II, you probably won't be able to tell the difference. Text printed crisply in roman, italic, and boldface, as well as in large and small point sizes. My sample line drawing looked equally well defined, as did thick and thin rules and pie-chart circles generated from Harvard Graphics. The hash marks that differentiated pie slices were sharp in even the most intricate patterns when I printed in high-quality mode. Standard and draft modes (chosen through the software-the printer doesn't offer these selections) showed relatively more broken lines and fuzzy curves, but not unexpectedly so. None of my test printouts produced print-quality problems like staining, unwanted vertical lines, or toner blotches.

I also printed mailing labels and envelopes. The HP manual cautions you to...
use only laser-quality adhesive-label stock—specifically, stock that can withstand the printer's 392°F fusing temperature. My sample stock met this requirement and worked flawlessly, both in terms of print quality and in its ability to pass through the paper path without hanging up. Envelopes had to travel through the front exit or else they'd become so wrinkled you'd think the post office had already gotten its hand on them. With this condition, envelopes printed fine and were aided by the retractable guides on both the standard and optional paper trays.

Easy Assembly
Setting up the IIP is simple. A Quick Start guide is meant to ship along with the standard, well-written user's manual; it focuses on setup procedures. My review unit lacked the guide, but I didn't miss it. The EP-L toner cartridge slips easily into place once you've opened the IIP's front cover. Toner didn't leak from the cartridge even after I broke the seal.

Serial and parallel ports sit on the unit's back. You plug in the proper cable (cables cost extra), make sure the control window displays the correct interface, change AUTOEXEC.BAT, and you're in business. The IIP can even accommodate serial RS-442 cabling if you need to use a cable more than 50 feet long. You remove the back cover and reposition the serial interface jumper block—nothing a novice can't do with the manual at hand. Attaching the optional lower paper tray is similarly straightforward and only requires turning a few screws.

A nice touch that's unique to HP's printer line is the cleaning paper to maintain rollers. You generate the paper by instructing the printer to perform a self test; it creates a page of sample fonts with a wide black band. HP suggests that you run this page through the print cylinders each time you replace the cartridge, which has a life of 3500 pages.

However, I'd dock design points for the placement of the density-adjustment lever, which sits inside the front cover. To reach it, you have to open the printer's folding panel, which is a little out of the way. Also, the printer's heating element rests near the exit of the front paper tray and therefore close to fingers that may be gathering printed pages. Warning labels caution against touching it.

Economical Extravagance
Lower-cost desktop laser printers won't replace brawnier and speedier printers like the Series II as a shared peripheral on a network. For example, HP rates the IIP at a 6000-page volume per month, while the Series II logs in at 12,000 pages. Nor will the downsized version take over in commercial desktop publishing shops, where speed and volume equal profits. But the IIP may be ideal for a small business's correspondence. Also, departments within large corporations can tap the IIP to print correspondence and company newsletters and avoid bottlenecks at the network printer.

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Alan Joch is a BYTE technical editor. He can be reached on BIX as "ajoch."

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Circle 90 on Reader Service Card
DOS application switchers bring help for the hurried

Stan Miastkowski

If you’re like most users, you’re hearing the siren call of operating systems like OS/2 that do multitasking and easily switch between applications. Normally, the process of switching between DOS applications can be painful, especially when you need to run three or four applications on a regular basis, with each application taking up most (if not all) of your available RAM space. You must store the file you’re working on, exit the application, and then start the next one.

DOS shells, such as XTree and Norton Commander, and menu programs have helped a bit, allowing you to switch between applications a little more quickly. But it still takes time (and lots of keystrokes).

The Shell Game

One solution for the problem—in some applications—is to “shell out” to DOS, leaving all or part of your application still in memory. But this DOS EXEC ability often can’t be used, because once you’re running a major application, there’s very little RAM space left to run another.

Several utilities, called application switchers, try to overcome these problems. An application switcher takes your running application, stores an image of its state in extended or expanded RAM or even on a hard disk, and immediately loads another application to take its place. This process theoretically leaves maximum RAM space for each application, letting you run even the most RAM-hungry programs without having to completely shut down your other program.

I took a look at five different packages: AutoSwap 1.2, Dr. Switch 1.7, HeadRoom 2.0, Software Carousel 3.0, and Switch-It 3.0. While these are all switch applications, they are vastly different programs. Some are simple and inexpensive, but a couple are extremely complex.

None of these packages brings true multitasking to DOS. As switchers, the images of the nonrunning programs that they switch to the background are held in a state of suspended animation. For this reason, I did not review programs, such as DESQview, that offer complete environments for running applications as well as limited multitasking.

I ran all the programs on a 10-MHz AT clone with a 66-megabyte (29-millisecond) hard disk drive. The system had a total of 3.5 megabytes of RAM. Using the All Charge Card and its device driver, I configured the additional memory (above 1 megabyte) as 512K bytes of extended memory and 2 megabytes of expanded (EMS 4.0) memory. The 512K continued
bytes of extended memory is required to speed up Windows/286, which I also tested with the switchers.

**AutoSwap**

At $49, The Lambda Group's AutoSwap is the least expensive of the group reviewed. It's simple to install and use, but it also has some limitations.

AutoSwap works only with programs that directly shell out to DOS without ending. Most major applications can do this, including dBASE, Paradox, Lotus 1-2-3, WordPerfect, Microsoft Word, and XyWrite. But if you want to use it with a program that won't shell out to DOS, you're out of luck.

Installing AutoSwap is a snap; there's an installation program on the distribution disk. When it's done, AutoSwap's installation leaves a tiny (6K-byte) file, called AS.EXE. All the installation files are copied the AS.EXE file to the new disk, however, take up over 250K bytes.

Although the company says AutoSwap is not copy-protected, you can only use the installation program once. When I attempted to install AutoSwap on a different machine in the BYTE Lab, it gave me an "already installed" message and then aborted. To get the program to work, I just copied the AS.EXE file to the new system. The experience would have been considerably less frustrating if the process had been explained in the manual.

Because it's small and simple, using AutoSwap doesn't take much effort. For example, while running the XyWrite program, I shelled out to DOS using the DOS command. Normally, I'd try to start the Paradox database by typing PARADOX. Then I would get a message from Paradox saying there wasn't enough memory to run it. But with AutoSwap installed on my disk, all I had to type was AS PARADOX. The image of the XyWrite file was immediately saved to expanded memory, and Paradox had all the room it needed.

I then shelled out to several other programs through AutoSwap. Each time I started another program, AutoSwap left a new 6K-byte kernel in main RAM. The program is smart, too. Unlike some of the other switchers, AutoSwap dynamically allocates RAM space for the image. This makes the most efficient use of storage and lets you shell out to numerous programs, depending on how much storage you have available.

My major complaint about AutoSwap is that it's easy to lose track of where you are and just how many levels you have shelled out to. AutoSwap lacks a pop-up menu to tell you where you are, which makes it impossible to switch directly from application to application. If I wanted to run XyWrite after shelling out to three other programs, I had to exit (and unload) each program in the reverse order from which I opened them before I could get back to the word processor.

AutoSwap is best if you only want to work with two or three programs. Essentially, it simply extends the DOS EXEC facility. AutoSwap isn't a do-all, end-all utility, but what it claims to do, it does well.

**Dr. Switch**

The interestingly named Dr. Switch is also inexpensive at $59.95. In the way it operates, Dr. Switch closely resembles AutoSwap, but with some crucial differences.

Like the other programs here, Dr. Switch has a standard installation program. You can install it as many times as you wish. The actual program is small, too: about 25K bytes of RAM.

As with AutoSwap, you can use Dr. Switch only with programs that shell out to DOS. From XyWrite's command line, I typed DRSWITCH PARADOX to start Paradox. Each time that I shelled out to a new application, Dr. Switch left a 14K-byte kernel behind while it stored my initial application's image in expanded memory.

But I was in for a surprise. When I shelled out to my fourth program, there was a long delay and lots of activity on my hard disk drive. What had happened is that I had run out of memory space, so Dr. Switch stored the image on the disk. Unlike AutoSwap, which dynamically changes the size of the image, Dr. Switch uses a full 640K-byte partition for each image. If you have enough expanded (or extended) memory and you switch between only two or three applications, that shouldn't be a big problem, but it is a disadvantage.

Like AutoSwap, Dr. Switch doesn't have an application menu, although its setup routine asks whether you want to use expanded or extended memory or the hard disk for storing application images (see photo 1).

Dr. Switch's user manual, available only as a README file on the hard disk, makes it clear that the program is optimized for use with dBASE and its clones. You can use dBASE's RUN command to shell out immediately to another program.

Dr. Switch also has two other important features that AutoSwap lacks. It lets you load and unload TSR programs. For example, I use SideKick's Notepad along with Procomm, my communications program, but I don't use the Notepad at
TIME TO SWITCH

REVIEW

other times. So I wrote a small batch file that loaded SideKick with Procomm. When I exited back to XyWrite, Dr. Switch unloaded SideKick along with Procomm.

Dr. Switch also has the cutely named program, Scalpel. This is an extended version of the program's ability to swap out TSRs. But unlike the batch file above, Scalpel unloads all TSRs that have been loaded prior to the program you shall or out to. Scalpel is handy for using TSRs that don't normally opt for peaceful coexistence.

HeadRoom
Helix Software's HeadRoom, which has been available for almost two years, now comes in version 2. It is a complex program with a raft of features and extra utilities. At $129.95, it's also the most expensive of the programs reviewed here. Although it does an outstanding job of swapping applications, its real forte is in handling TSRs. It can swap virtually any number of TSRs to extended RAM or to the hard disk, leaving a tiny kernel in base RAM. It also lets you pick and choose among individual or combinations of TSRs.

HeadRoom is also one of the largest programs here, taking up about 512K bytes of RAM at all times. Unlike AutoSwap and Dr. Switch, HeadRoom can work with any application.

It is relatively simple to set up applications to switch from using HeadRoom. The program's application setup screens (see photo 2) are straightforward. HeadRoom essentially turns your applications into sophisticated TSRs by letting you specify a hot key to call each application. If you haven't previously started the application, the hot key will start it; if you have, the hot key calls up the image.

The version of HeadRoom that I tested used a fixed partition size of a full 640K bytes for each image. So once again, my 2 megabytes of expanded memory were sufficient to store the images of only three programs. But HeadRoom's setup lets me specify whether to use RAM or the hard disk for swapping images, so I get around the problem by telling the program to swap my less-used applications to the hard disk instead of RAM. It's a slow solution, but it works.

The issue may become moot, though. Helix Software says that by the time you read this, an updated version of HeadRoom will let you determine the size of the partition for each application. The company also says that this version will have a "cut and paste" feature for copying data between applications.

Like Dr. Switch, HeadRoom also lets you couple TSRs with specific applications. It's a simple matter of assigning a batch file (instead of the application itself) to a partition. HeadRoom's other (and separate) TSR-control features let you load and unload other TSRs at almost any time.

Software Carousel
SoftLogic Solutions' Software Carousel ($89.95) sits in the middle of the programs reviewed here. It's also the most difficult of the programs to learn and to use. Much of the blame rests squarely with the manual.

Software Carousel is powerful, but much of its power lies hidden behind numerous confusing screens, not to mention on-line help that is so sparse that it's seldom any help at all. But of the full-featured application switchers, Carousel is the most powerful because it lets you determine how much memory each application partition should use. This is far better than the current versions of Dr. Switch or HeadRoom, which grab 640K bytes of RAM whether an application needs it or not.

Carousel's setup screen (see photo 3) allows you to enter the amount of RAM needed for an application. Powerful applications like Ventura Publisher or Paradox require full 640K-byte partitions, but if you can get by with less, so much the better. Fortunately, this is one area where the manual is helpful. To store data, most applications need more space than the size of their command (or executable) files; the problem is finding out exactly how much space. SoftLogic Solutions provides a list of many common applications and the space that they require. (For applications not on the list, you'll need to experiment.)

After you've set up the partitions, swapping applications is a simple matter of pressing hot keys. I found it hard to get used to the blank screen pauses while the swap took place. A miniature gas gauge finally appears on the screen to show progress, but only after a couple of seconds have passed.

Carousel has its quirks. It essentially takes over your system's base RAM, with its huge 540K-byte kernel always resident. This method, with applications sitting within the kernel and being swapped into and out of it, is a far cry from the tiny kernels the other programs here use. But it works.

Carousel can also work with specific TSRs by using batch files within partitions. In fact, the manual suggests that you load only global TSRs (e.g., disk-caching software) before you start Carousel.

Switch-It
In some ways, Switch-It is the sleeper of this bunch. It's a program that I liked immediately and liked even more as I got to know it. It is full of thoughtful little touches that show that its developers didn't just rush something out the door.

The program, which costs $79.95, has something of a dual personality. You can use it as a plain-vanilla automatic menu program (if you would rather not swap images), or you can use it as a full-fledged application swapper. In addition, you can use it as a combination of the two.

Of the programs here, Switch-It is the only one that pops up a menu on the screen when you're between applications (see photo 4). I found this handy, but if
you're fond of DOS shell programs, regular use of Switch-It might become annoying.

One of Switch-It's nicer features is its installation. The program searches your entire hard disk (or multiple disks, if you have them) for common applications and then presents you with a list asking you which of them you want added to the Switch-It menu. Like Carousel, Switch-It uses variable-size partitions for its application images and knows exactly how large the partitions for common applications should be.

A separate configuration program lets you add just about any application. You can specify the particulars for each, and the setup even checks to see if the path names and command filenames that you enter actually exist. If they don't, you are told immediately.

You do, however, need to specify the partition size for applications that you add to the memory. This requires a bit of experimentation—and a trade-off. If you have plenty of RAM (or don't mind slow-speed image transfers to and from the hard disk), you can be sloppy and just specify a large partition size. Once you are set up, Switch-It lets you use hot keys either to go directly to your applications or to choose the applications from the menu.

Unlike the other programs here, the amount of main memory that Switch-It requires varies depending on the application you are running. In addition, Switch-It switches its own code in and out of your expanded memory (or your hard disk). That's not necessarily a disadvantage, just a different way of doing things.

Switch-It is also the only program here that currently has a built-in cut-and-paste capability. You can also choose several different formats for the text, depending on the application into which you'll paste it. The cut-and-paste feature works flawlessly; it alone is almost worth the price of the product. And like the other programs, Switch-It can also include specific TSRs within application partitions, swapping them in and out along with the program.

Of course, Switch-It isn't perfect, and its one glaring shortcoming is in the graphics realm. Switch-It is the only program here that blew up when switching from a Microsoft Windows partition to a nongraphics partition. In fact, the whole system just locked up and required rebooting. It wasn't happy with other graphics-based programs, either. If you need graphics, you'll have to choose another application switcher.

Making the Switch

Even though all the programs reviewed here have their particular idiosyncrasies, they all do what they claim. If you constantly work with two or three different applications and need to switch regularly among them, the simple programs that use the DOS EXEC function aren't a bad choice. They're inexpensive and easy to use. Conversely, HeadRoom, Software Carousel, and Switch-It make the most sense if your hard disk is filled with numerous applications and multitudes of TSRs.

But the main question is, should you even buy an application switcher? That depends. None of these application switchers works wonders if you have a system with little RAM and a slow hard disk drive. Although all the manufacturers claim that you don't need a full 640K bytes of RAM to use them, I found it's the only way to go. Extended or, preferably, expanded RAM is another necessity, and the more the better.

Switching programs to and from a slow hard disk drive is something you'll want to avoid. I tried the programs on a BYTE Lab AT clone with a slow (65 ms) hard disk drive using a 3-to-1 interleave controller. The results were discouraging. Swapping applications on that hard disk typically took 20 to 40 seconds. In that time, I could have quite one application program and loaded a new one. Even on my fast hard disk drive the switchers took 5 to 15 seconds to swap applications.

There are exceptions, though. A few programs go through a lengthy setup as they load (such as building extensive indexes) and can take a minute or more to start. If you use such a program, a 20- to 40-second wait for switching applications may not be so bad.

Finally, if what you really need is multitasking, an application switcher can't help you. You cannot switch, say, from a communications program doing a file transfer to another application. The transfer will be suspended, and you could lose the communications link.

The fact is that application switchers aren't for everyone, and some users may even be disappointed. But if you don't expect more than it promises, and if your situation warrants one, an application switcher can be a handy tool.

Stan Miastkowski is a BYTE consulting editor, managing director of K+S Concepts (a documentation and consulting firm), and editor of the OS Report newsletter. He can be reached on BIX as "stanm."

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Get the Max from Your 80386

386Max lets you manage your memory and reclaim high RAM from DOS

Alex Lane

Even though your 80386 microprocessor’s 8086 emulation mode can address a full megabyte of memory, MS-DOS artificially limits you to only 640K bytes of conventional memory. That’s a real loss, since most 80386 systems come with several megabytes of memory. There is an answer, though, with 386Max. It maximizes your machine’s performance by making available unused portions of RAM that lie in the 384K-byte region between 640K bytes and 1 megabyte.

You can use the memory recovered by 386Max either to store TSR programs, such as SideKick, or to store device drivers that normally would be loaded into high conventional DOS memory.

I worked with 386Max Professional 4.07, which also included a copy of 386Load 3.01, a program loader that works with 386Max. That package costs $129.95, but you can also buy 386Max without 386Load for $75.

Unlike most software, 386Max is particular about the machine it runs on. As its name implies, it works only on 80386-based microcomputers and requires a minimum of 256K bytes of extended memory. (A version for 80286-based machines, called Move 'Em, should be available by the time you read this.)

I ran 386Max on a 16-MHz ARC 386i microcomputer with DOS 3.3, 512K bytes of memory on the motherboard, 1.5 megabytes of extended memory, a VGA display, and a 40-megabyte hard disk drive that behaves (with the help of a device driver) like two 20-megabyte hard disk drives.

Flexible Options
Installing 386Max is easy; you just copy the two files 386MAX.SYS and 386MAX.COM to your hard disk drive. You then edit your CONFIG.SYS file to include the device path for 386MAX.SYS.

If no options are supplied in this line, then all extended memory is allocated as EMS, and the 64K-byte segment starting at address E0000 is used as the EMS page frame. In addition, 386Max copies the contents of all ROMs into areas of RAM, which are then remapped so that when the original ROM code is executed, it is read from the faster RAM instead of the slower ROM. Finally, any memory “gaps” between the highest system board memory address up through address FFFFFFF are filled in. These defaults should be adequate for most needs.

The basic options 386Max provides concern specifying how to map extended memory, what page frame segment to use for EMS, and whether to swap conventional and extended memory. You can pass many advanced options to 386Max by specifying the name of a file containing them on the driver installation line.

Advanced options let you prevent 386Max from automatically doing things, such as swapping ROM for RAM or filling in high memory above the display adapters. Other options specify memory used

386Max includes a utility that lists how your system allocates DOS and extended memory.

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areas as either ROM or RAM, instruct 386Max to reclaim shadow RAM from systems using the Chips & Technologies' AT/386 chip set, and enable or disable the Weitek 1167 math coprocessor.

When I ran 386Max with no options, the program found 96K bytes of free, high conventional DOS memory and reserved 64K bytes of memory starting at E0000 for EMS. When I specified EMS=0 as an option, no EMS memory was allocated, so I got 160K bytes of high conventional DOS memory available. Interestingly, when I replaced the VGA monitor and card with a CGA monitor and card, 386Max did not detect what should have been a gap in memory between 640K bytes (address A0000) and the start of CGA memory (address B8000). I could, however, make 386Max aware of the gap by adding a RAM= option statement to the device driver line in the CONFIG.SYS file.

Another option, called SWAP, is useful for 16-bit machines with installed 80386 accelerator cards and 32-bit extended memory. This option permits conventional memory to be swapped for the same amount of extended memory.

One nice feature incorporated into the design of 386Max is the ability to prevent installation of the 386Max driver by pressing the Control, Alt, and left Shift keys while rebooting. This feature can be a nerve-saver if you have trouble during installation and can't find a DOS system disk with which to boot your system.

Loading in High RAM
With 386Load, you have to enter three commands to load a program into high memory. First, you "activate" loading into high memory by running the program 386MAX.COM with the parameter LOADHIGH. You then invoke the memory-resident program by name. Finally, you "deactivate" loading into high memory by running 386MAX.COM with the parameter LOADLOW.

To load a device driver with 386Max, you need the driver 386LOAD.SYS. You start by modifying the CONFIG.SYS file and replace each line that loads a driver with a line like the following:

DEVICE=c:\386LOAD.SYS
GETSIZE PROG=c:\DRIVER.SYS [arguments]

When you have finished modifying the configuration file, you reboot the system; 386Load pauses at each line and informs you whether you need to include

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the keyword SIZE= followed by a number for any particular driver.

For example, when 386Load loaded my hard disk device driver, it told me that no SIZE= keyword was needed. However, when it came to install the driver that allows my debugger to run in extended memory, 386Load indicated that the keyword SIZE=10048 had to appear on the line. After 386Load determines the initialization and resident sizes of the device drivers in this pass, you edit the CONFIG.SYS file to make the requisite keyword changes, and you're done.

Finding What's What

In addition to recovering stray chunks of RAM above 640K bytes, 386Max can display various statistics regarding memory use in your system. A utility provides a detailed memory map of resident programs that you can analyze to help optimize memory utilization. You can also generate reports to show EMS usage, memory-access times, the locations of ROM in memory, and an overall map of system memory usage.

The major problem with using 386Max in any but the most plain-vanilla configuration is the degree of expertise you must possess to properly determine what will and won't work with it. For example, many programs, such as Windows and Software Carousel, get confused if memory allocation chains extend up above 640K bytes.

Qualitas supplies a large amount of information pertaining to the use of its product with, for example, DOS 4.0, AutoCAD's AutoLisp, and PS/2 computers. Unfortunately, it's not easy reading for the nontechnically oriented user. In general, the documentation is adequate. Product support from Qualitas requires you to have the disk serial number at hand before talking with a technician. My experience on the phone confirmed the strictness of this policy.

The only degradation in performance I noted was a slight pause after keying Ctrl-Alt-Del to reboot the machine when using 386Max. Otherwise, the software worked fine.

If you operate an 80386 system with unusual characteristics or unusual software and you need a flexible piece of software to deal with the problem of reclaiming and using high memory, 386Max is the right choice.
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Two Mac Hard Disk Drives Deliver Speed

Thanks to the Macintosh's built-in SCSI port, Mac users can pick and choose among feature-rich external hard disk drives. I recently looked at two newcomers: Toshiba's MacKit 140E, with 140 megabytes of formatted storage for $1695, and Rodime's Cobra 210e, a $2549 drive with 210 megabytes of formatted storage.

The two external hard disk drives have a lot in common. Both sport disk-access indicator lights, two SCSI connectors, and a handy push-button SCSI ID selector switch. Each uses embedded SCSI controllers to avoid complications involved with using a SCSI-to-ESDI or SCSI-to-ST506 drive interface.

Each drive supports the full SCSI disconnect/reconnect command set, so that in a lengthy I/O operation the drive will disconnect from the SCSI bus, giving another SCSI peripheral access to the bus until the drive has data ready for the Mac. At that point, the drive arbitrates and then reconnects to the bus.

The Cobra uses zoned-bit recording, a format in which more sectors exist on the outer tracks of the disk platter than on the inner tracks. This format allows more data to be crammed on the disk and provides for faster transfer rates. The MacKit uses a spiraled format on its platters that accomplishes the same purpose.

Both drives have internal look-ahead buffers to speed sequential read operations (the MacKit's buffer is 32K bytes; the Cobra's is 48K bytes). Finally, both feature removable internal resistor packs that terminate the SCSI connector. This lets you use the drive as a stand-alone SCSI peripheral or, if you remove the resistor, as a drive in a chain of SCSI devices.

The Cobra uses a 3½-inch hard disk drive with an 18-millisecond access time. It's a fast drive in a svelte housing; it weighs about 6 pounds. The MacKit, with a 5¼-inch 23-ms hard disk drive, weighs 11½ pounds. Each is designed to be tucked under a Mac Plus or SE.

The Cobra includes two 300-watt filtered power outlets, controlled by the drive's power switch. You can hook the Mac and an external monitor into these outlets. If the Cobra has a hardware problem, an I/O light flashes an error code that indicates which component failed. The MacKit doesn't offer additional outlets or indicators, but Toshiba mounted the fuse externally for easy access.

Rodime bundles Fifth Generation Systems' Fastback backup software with the Cobra. Utility software formats the hard disk (the interleave is user-selectable), tests it, lets you build partitions, and installs the driver. Rodime provides its own software; the MacKit's software comes from Universal Mac Products.

I used both drives on a Mac II for several weeks and had no problems. The Mac II had an Apple internal 40-megabyte hard disk drive, 5 megabytes of RAM, a SuperMac 19-inch monitor, and System 6.0.3. I ran the BYTE low-level benchmarks and an abbreviated set of the optical storage benchmarks (see "The Optical Option," October 1989 BYTE) to simulate file operations. The results (see table 1) show that the Cobra drive's faster access time and larger look-ahead buffer improve hard disk drive performance. The Toshiba is no slouch, either; it matches the Cobra on disk writes.

Because of their size and speed, both drives are suitable mass storage devices for a file server. In addition, the Cobra 210e offers several conveniences that can make it a useful second hard disk drive for your Mac.—Tom Thompson

---

**Table 1: Benchmark results.** The Cobra's larger look-ahead buffer and faster access time speed up read operations. Times are in seconds, except for those for the optical test, which are in minutes:seconds.

<table>
<thead>
<tr>
<th>Test</th>
<th>Cobra</th>
<th>MacKit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seek 1-sector</td>
<td>10.9</td>
<td>14.75</td>
</tr>
<tr>
<td>Seek 32-sector</td>
<td>25.32</td>
<td>31.67</td>
</tr>
<tr>
<td>Read 9.44</td>
<td>19.14</td>
<td></td>
</tr>
<tr>
<td>Write 8.07</td>
<td>8.02</td>
<td></td>
</tr>
<tr>
<td>Write 3.45</td>
<td>3.62</td>
<td></td>
</tr>
<tr>
<td>Read 1.32</td>
<td>4.37</td>
<td></td>
</tr>
<tr>
<td>Optical 25:39</td>
<td>27:52</td>
<td></td>
</tr>
</tbody>
</table>

---

Cobra 210e
- Rodime Systems
- 901 Broken Sound Pkwy, NW
- Boca Raton, FL 33487
- (407) 994-5585
- $2549
- Inquiry 855.

MacKit 140E
- Toshiba America Information Systems, Inc.
- Disk Products Division
- 9740 Irvine Blvd.
- Irvine, CA 92718
- (714) 583-3150
- $1695
- Inquiry 856.
CocoNet Unites Unix, Novell, and DOS

Imagine hooking your AT-compatible computer into a network that offers powerful 32-bit server-based applications in addition to the usual file- and print-sharing services. NetWare 386 and OS/2 LAN Manager developers are scrambling to provide a robust, multitasking, protocol-independent network operating system that can nurture and sustain such applications. CocoNet delivers it now.

The secret? The Santa Cruz Operation’s (SCO) Xenix-Net, a Xenix implementation of Microsoft’s MS-Net. Xenix-Net is the core of CocoNet. It enables CocoNet to link a Xenix server to DOS clients through the NetBIOS and server message block protocols, using the familiar MS-Net net start, net share, and net use commands. Clients can map virtual DOS drives to Xenix subdirectories and use the connection to establish fast virtual terminal sessions with the Xenix host.

If you haven’t heard much about Xenix-Net, you’re not alone. The product has been around for several years, but it’s suffered from a lack of support for popular network hardware. In addition, the necessary MS-Net software has normally been bundled with complete MS-Net-based products and not sold separately.

CocoNet solves these problems and adds some polish to Xenix-Net. One nice touch is that CocoNet can coexist with Novell. I’m writing this on a machine that’s both a Novell and a CocoNet workstation. With CocoNet’s packet driver interface, the Ethernet adapter in my computer runs two protocols: the CocoNet-supplied version of Novell’s IPX and CocoNet’s NetBIOS. Novell links me to two file servers that I share with PC and Mac users (the latter by way of NetWare for Macintosh and AppleShare), and a couple of laser printers. CocoNet adds another file server (the Xenix machine). That is also what CocoNet’s PC and Mac LAN counterparts are struggling to become: an application server.

What applications? For starters, there are SCO applications that are just like Lotus 1-2-3 and FoxBASE+ except that they run in the 80386’s native mode under a secure, multiuser, multitasking operating system. The CocoNet (and Xenix-Net) Int5c library provides one way to build server-based applications that speak NetBIOS to DOS clients. CocoNet’s decoupling of the client’s protocol stack from its network hardware suggests an even more interesting possibility: TCP/IP. Support for this protocol, which could link DOS workstations to mainstream Unix LAN activity, is high on CocoNet’s agenda.

CocoNet could help break down the barriers that separate Unix and DOS communities. It makes Unix less of a threatening, all-or-none alternative and more of a complement to what PCs and PC LANs do well. Think about it. Do you build a multiuser database on top of a new operating system like NetWare 386 or LAN Manager, or do you use tried-and-true Unix? Because it adds Unix connectivity without compromising your PC’s role as a DOS-based LAN workstation, CocoNet makes the latter a more likely choice. Users don’t want to give up their personal computers, but they’d like those PCs to share central data and central processing of that data. That’s not a new problem, and CocoNet isn’t a new solution. But it’s a good one.—Jon Udell

CocoNet
CocoNet, Inc.
4275 Aurora St., Suite E
Coral Gables, FL 33146
(305) 447-4608
Server adapter and software, and DOS client software: $2595
Inquiry 857.

A Pip of a Utility

Back in my CP/M days, I was a master of the Pip (peripheral interchange program) command. I copied files from disk to disk and accomplished a great deal with this simple command and some well-chosen options. When I changed to MS-DOS, I missed the convenience of Pip—until I got a copy of Zeamon.

DOS limits you to a few wild-card options, used with the asterisk and question mark. Zeamon is a utility program that adds new commands and wild-card options to the standard DOS and OS/2 command processors. It lets you copy and delete files, display formatted directories, generate a formatted list of specific files, move and update selected files, or execute a command string for each file that matches a set of criteria or filters.

A sample Zeamon command, including all the options, looks like this:

```
Z COMMAND [d:]source [+-filter]
[d:]target [/a/b/c/d/e
/f/k[RH]/m/n/o/p/q/r
/o[NESD]+] [/t/v/w/x].
```

Brackets enclose the options. You enter Z, the command (copy, delete, dir, execute, list, move, or update), the drive/ path name, and the name of the source files. The plus and minus signs are inclusion and exclusion filters that designate a path name, filename, extension, or wild card that should be included or skipped over in a directory search of the source.

The alphabet soup of options controls the sort order, processing of files by dates, running in batch mode, subdirectory creation, screen display, and whether you want to confirm each file operation, to name only a few possibilities. I did need a bit of practice to remember all Zeamon’s options, but just typing Z displayed a sample command line and a list of all the choices.

The Zeamon reference manual is adequate. It could use some more examples and a fuller explanation of the delete and execute commands. I had no problems, but I had the advantage of working with programs similar to Zeamon in the past.

Unlike many DOS shell programs that are TSR programs, the Z.EXE program requires RAM only when you run it. Zeamon uses a 63K-byte buffer for copying, moving, and updating files. You can shrink the buffer by setting an environment variable to specify size in K bytes.

There are two versions of Zeamon. Z.EXE is a dual-mode program for OS/2 and DOS 3.x and higher. If you are running a lower version of DOS, you must use ZD.EXE, the DOS-only version.

Programs like Zeamon aren’t new. Several DOS shareware or public domain programs do much the same job. However, Zeamon is easy to use, and all the commands use the same syntax for all options. It is ideal for users like me who are addicted to using the command line.

—Stanley J. Wszola

Zeamon 1.0
SoftCare Systems, Inc.
925 Clifton Ave.
Clifton, NJ 07013
(201) 473-2002
$69
Inquiry 858.
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FRIDAY, 2/9, 8 PM EST. Computer animation for kids of all ages.
Steve Segal, creator of the well-known Amiga-animated film “Dance of the Stumblers,” joins our new animation conference in a CBix session. Mr. Segal is presently working with American Interactive Media, where he’s directing interactive, computer-animated stories for children that will be released on CD-ROM. (join animation/cbix).

Exchange Updates
Amiga Exchange—Multimedia and the Amiga will be explored during February in the “multi.media” topic of the “amiga.arts” conference. And more specifically, you can discuss the use of optical drive file systems in the “amiga.hw” conference.

IBM Exchange—This month, Colin Sampaleanu, author of Telix, visits BIX to discuss his popular telecommunications program. You’ll also find in-depth discussions on hard drives, OS/2, communications programs in general, and LANs.

CBix sessions are held every weeknight at 10 PM EST in the IBM Exchange. Beginning and intermediate PC-users may be especially interested in the question-and-answer sessions that are held every Wednesday night in this time period.

Look for a schedule of upcoming CBix sessions in the topic “info.cbix” in the “ibm.exchange” conference.

Mac Exchange—in “mac.products,” we’ll look into on-line multimedia, consider the new products recently introduced by Macromind, and examine the question of Mac hardware as a multimedia platform.

Meanwhile, the Mac Exchange will continue its discussion on Mac hardware and software.

And the tutorial on C programming will continue in the “mac.novice” conference.

Writers Exchange—Three new conferences have been added to this exchange:
newwriters, where aspiring writers can turn for insights and tips on getting started,
write.fiction, for people who are specifically interested in writing fiction, and writers.talk, for those who just want to talk one-on-one with professional writers. At the moment, Greek and Latin classics are hot topics here.

Interactive Games Exchange—Now you can invite your children to join you on Sunday afternoons for 90 minutes of on-line fun and activities at the gazebo/town.hall. The activities, which are designed for children between ages 5 and 10, will include kiddie trivia, on-line typing lessons, and ASCII art. (You’ll also find inspiration here for off-line arts and crafts activities.) You’ll enjoy story hours, during which you can read stories to your children and help them interact with others. And you’ll be able to chat with people from around the world. A program for teenagers is also in the works. (join gazebo/town.hall)

Elsewhere in the Interactive Games Exchange:
Richard Pini, co-creator and publisher of ElfQuest, will answer questions about Elves and their world. (join eq)

Programs and applications related to on-line gaming are discussed in the dd conference. (join dd)

There’s a whole lot of on-line socializing going on at the gazebo. (join gazebo)

BIX Conference News
Two more companies now offer customer support in BIX Technical Conferences:
Rational Systems, which will support its incremental C compiler and development environment, Instant-C (join rational.ic), and
The Periscope Company, which will support its debugging programs. (join periscope)

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This is it! The big moment has arrived. You have been working on this project for months, and the time has come to present it to the decision makers. They will decide whether you have wasted your time or whether your idea can go into production. Your stomach is doing flip-flops. All eyes are on you. You reach for your flip charts and overheads.

Flip charts? Overheads? Isn’t this the computer era? Surely, with all the high-speed machines, CD-ROMs, synthesizers, and image-processing capabilities available, there must be something that will convey your message better than flip charts and overheads.

Well, there is. It’s called multimedia, and it marries the best of image, voice, text, and video processing. It’s the subject of this month’s In Depth section.

In “The Four Multimedia Gospels,” Phillip Robinson looks at multimedia through the eyes of the players. He discusses what it is according to Apple, IBM, Sony, and others. Strangely enough, the definition varies depending on whom you talk to, but there are similarities.

Then, in “Beyond Hype,” Rob Lippincott discusses multimedia today and tomorrow. Where is it now, and where is this new merger of technologies going? Currently, a lot of multimedia is hype. Although the technologies exist, the bridges between them are still largely mythical, holding off a potential explosion of applications. Will you ever see them?

Next, in “Birth of the BLOB,” Tim Shetler delves into the database design issues for multimedia. He shows how you can save digitized images and sounds in a relational database as though they were normal fields in the file, right alongside text fields. Multimedia databases might change the way you do business.

And in “Desktop Video Studio,” Rick Cook explores how you can make that presentation more exciting now, before the multimedia revolution becomes widespread. He looks at the hardware and software available today for your current microcomputer to enable you to create videos to replace those flip charts and overheads in your next presentation.

In the final analysis, the name of the game today seems to be integration. The industry has all kinds of incredible technologies available to it, but trying to pull them together and use them in conjunction with one another is still relatively uncharted territory.

It’s no different for multimedia. The beginnings of an integrated approach are in place, but, right now, that’s all you have. Using multimedia today is far from instinctual, and in some cases, it’s downright difficult. The technology is there, but it still has a way to go before it is easily accessible.

—Jane Morrill Tazelaar
Senior Technical Editor, In Depth
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The Four Multimedia Gospels

According to Commodore, Apple, IBM/Intel, and Sony/Philips

Phillip Robinson

Even if you’re not sure what multimedia is, you probably know it when you see it (and hear it). If a computer is showing a graph, formatting a page, playing a tune, or even shading a three-dimensional model, that’s not multimedia. If it’s showing a graph in one window and rotating a three-dimensional model in another while playing a tune, you’re in the right neighborhood. But if it plays music from a compact disk (CD) while animating the graph and superimposes the result on a prerecorded video—that’s multimedia.

When you combine standard data processing with graphics, animation, speech synthesis, audio, and video, you’re part of a phenomenon in computing. Multimedia uses the computer to integrate and control diverse electronic media such as computer screens, videodisk players, CD-ROM disks, and speech and audio synthesizers. If you make logical connections between those elements and make the entire package interactive, then you’re working with hypermedia.

The people who are inventing multimedia computing really don’t have any better definition than that. Computers vary in their abilities to handle the various elements of multimedia and hypermedia. Naturally, the computer manufacturers like to accentuate the positive aspects of their own systems. So they tend to define multimedia in terms of what their own systems do best. (This creates a technological version of the tale of nine blindfolded experts and the elephant. Each expert gives a different description of the animal at hand, based only on the feature he can feel.)

Just about any modern computer can handle text processing and produce basic sounds. Most computers can handle graphics pretty well, too, although they differ in details such as display resolution, color selection, and performance. (Such details can sometimes be quite important.) But the different computers start to spread apart when you look at animation—which is essentially high-performance graphics. When you examine high-quality audio, they move even further apart. And they are radically separate in their abilities to handle video—importing video signals from tape or camera, editing and merging video and computer-generated graphics or text, and exporting the resulting mix to videotape.

Finally, different strains of computers have quite different abilities to integrate all those elements. Each offers different operating-system and “authoring-system” software to create, read from peripherals (e.g., videodisk players, CD players, optical disk drives, and video cameras), combine, edit, and produce
multimedia or hypermedia presentations. This software is as critical to practical multimedia as the sophisticated video, audio, and graphics hardware.

In the future, the different approaches to multimedia may converge. File-format standards may well emerge, and authoring-system conventions may congeal. Until then, however, you can't understand the state of multimedia without knowing the four multimedia gospels according to Commodore, Apple, IBM/Intel, and Sony/Philips.

## COMMODORE

### Amiga: The Pioneer

While multimedia may be a new term to most computer users, the idea is business as usual to Commodore Amiga enthusiasts who believe the market is finally catching up with them. Even at its introduction back in 1985, the Amiga was touted by some as the best personal computer for video, audio, and graphics. The hardware of every Amiga is tailored to working with graphics and video—co-processors flying through graphics calculations, and display circuits easily synchronizing to the speed of standard video signals. That core strength may be responsible for the Amiga's survival in the U.S. Unable to rack up the volume sales of the Mac and IBM PC families, Commodore has sold a million Amigas, in part, by targeting the video niche.

When Commodore talks about multimedia, it emphasizes desktop video. But the relatively inexpensive Amiga hardware is also adept at graphics, animation, and sound manipulation. And that hardware is inhabited by a multitasking operating system that can interweave the various media. Commodore has recently added new, powerful authoring-system software to the mix, a package it intends to back (along with the latest Amiga hardware) with an advertising campaign centered on multimedia.

### Multimedia Built In

You can get the no-frills Amiga 500 with its 68000 processor and 512K bytes of RAM for just over $500. The high-end Amiga 2500 boasts a 68020 processor with at least 1 megabyte of RAM and expansion slots for lots more. Several developers offer 68030 add-in boards for the Amiga, and Commodore had its own $2000 25-MHz 68030 board (with a math coprocessor and 2 megabytes of 32-bit RAM) at Fall Comdex 1989.

Much of the Amiga's muscle for video and audio work comes from three custom chips named Agnus, Paula, and Denise. They accompany the standard 68000, 68020, or 68030 CPU and perform graphics, sound, and various I/O duties while the CPU attends to other tasks.

Agnus, for instance, is a graphics co-processor that includes dedicated circuitry called a *bitter* for quickly altering areas on the display. Denise has animation *sprites*, graphical shapes that you can define and move across the display background with simple commands.

Paula is in the Amiga's multichannel stereo sound. Paula also helps to shuttle information through the Amiga's bus network. Careful attention to timing lets the Amiga rapidly move lots of data (e.g., video, sound, and text) during the intervals between processor and video activities. That's vital for any multimedia machine because of the huge sizes of sound and video files.

But custom processors and quick data transfer aren't the Amiga's only hardware advantages. The display system is also cut to fit a video world: It packs in noninterlaced, interlaced, and overscan display modes. Video standards call for interlaced displays—where a "field" of every other line is displayed first, followed by a field containing the remaining lines. Overscan lets a computer paint pixels beyond the edge of the display. Most computers lack overscan and will show a border when their display is recorded on video.

The Amiga also keeps better time with video than other computers do. The chip that controls the Amiga monitor's vertical blanking interval generates a timing frequency that is the same as the National Television System Committee standard frame rate for TV. (NTSC is the U.S. video standard. Amigas also come in a phase alternate line version for the European standard.)

This frequency compatibility makes it much cheaper and easier to synchronize, or *genlock*, the Amiga's computer output with a video signal. Without genlocking, you can't edit video signals directly. You can buy Amiga genlock boxes for as little as $200. Add one to an Amiga 500, and you will have for far less the expensive computer that can synchronize with video.

If you start with an Amiga 2500 and add one of the more expensive genlocks available, you can synchronize with just about any video, from 8mm and VHS to Super VHS with yellow/cyan, ED-BETA, Hi8, and even broadcast-quality NTSC RS-170A.

The only display facet of the Amiga that comes up short for multimedia is the number of colors and display resolutions available. Even at its maximum overscan resolution of 768 by 480 pixels, the Amiga can't compete with the latest Mac and PC displays.

Although it can store 24-bit color images, the Amiga can display only 32 colors at a time when using its graphics hardware (one color must be transparent to merge with video). You can use all the colors from the 4096-color palette if you use the hold-and-modify mode, or 64 colors with the *Extra_HalfBrite* mode, but these modes slow down the processing and use more RAM.

Third-party frame buffers for still images with greater color depth exist, and Commodore has produced an add-in high-resolution display adapter with a 16-million-color palette from which you can display 256 colors at a time. In addition, the video strengths of the Amiga have attracted a host of video peripherals, including frame buffers, digitizers, time-base correctors, and special-effects devices. The Amiga 2000 even has its own video slot for adding video hardware boards.

The Amiga's custom processors can handle four channels of stereo sound. Paula contains sound- and speech-synthesizing hardware, including a full set of English phonemes. Third-party developers offer MIDI access through the serial port and many music and sound peripherals such as digitizers and samplers. Since more of the necessary hardware is already in the computer, these Amiga peripherals can be simpler and less expensive than peripherals that perform comparable functions on the PC and PS/2 systems.

### Tools—Old and New

The Amiga begins with a multitasking operating system, a great multimedia tool when you're working with different media sources and the relevant application programs. This operating system is hidden by the WorkBench user interface, with pull-down menus and icons a la Macintosh, Windows, or Presentation Manager (PM). Every Amiga uses the same system.

Although it took some time to debug the operating system, the Amiga is now surrounded by many graphics, animation, audio, and video software tools. These start with painting packages such as NewTek's Digi-Paint and Electronic Arts' Deluxe Paint III. Audio tasks can be tackled with Music-X from MicroIllusions (which supports MIDI sequencing).
and AudioMaster II from Oxxi (which is used for sampling and editing digitized sounds).

Sophisticated animation programs such as Photon Cel Animator from MicroIllusions bring motion to Amiga graphics and control genlocks or videotape editing. NewTek’s Digi-View lets you capture real-world images for graphics manipulation. VIVA from Mictron provides you with multimedia authoring capabilities.

Sheriff Systems’ Pro Video CGI is a character generator for the Amiga, one of the programs that has made the Amiga a big hit with both corporate and broadcast video professionals who need to add titles and logos to tape. All these programs are aided by the Amiga’s single interchange file format standard, which enables almost any program to accept and edit files from almost any other program.

But the big news for multimedia is Commodore’s new authoring system for the Amiga. Seen only in the beta stage by BYTE, the package (unnamed at press time) debuts this month. It links all the elements of multimedia development, offering a complete iconic programming language for wielding various media and applications together. It uses the Amiga’s multitasking ability, along with support for the ARexx interprocess language, to call other applications. It is built on a relational database that is compatible with dBASE.

By drawing a flowchart of icons and selecting choices in dialog boxes, using BASIC-style programming structures, you can create a new, independent, multimedia application. The new application will have its own icon and can be run without using the authoring package. It will be event-driven, not time-driven like the “movies” that simpler authoring systems create. And the new multimedia applications can be completely interactive, branching and looping as the original author intended. Commodore intends to offer templates for the authoring system that will pave the road to a variety of common presentations: annual reports, school courses, and the like.

A Multimedia Architecture

The Amiga has impressive hardware for multimedia: graphics coprocessors, display hardware that synchronizes with video and can overscan, and stereo sound and speech-synthesis circuitry. The only real drawbacks are the limited resolution and color depth of the graphics displays, the lack of hardware protection for multitasking memory, and the absence of a compression scheme for motion video.

The Amiga also has lots of software for multimedia: a multitasking operating system, a graphical user interface, scores of graphics, animation, audio and video applications and peripherals, a standard file format, and a new authoring system that can iconically create event-based, independent, multimedia productions.

On top of all that, the Amiga has a long history in video and graphics. It’s no wonder that Commodore believes that multimedia is a theory of machine architecture, and that the Amiga embodies that architecture.

**APPLE**

**Macintosh: A Graphical Nature**

The Apple Macintosh has proved itself by becoming the premier desktop publishing and desktop-presentation machine. The graphical interface allows printers and publishers to create and edit their work on-screen before committing it to paper or film. The Mac OS allows them to cut and paste information easily and smoothly between various programs. Apple sees multimedia, which it calls desktop media, as the logical next step, adding high-quality sound, live-action video, and animation to that base.

The glue that can bind all these elements together is HyperCard, which combines elements of a simple database, a hypertext program, a programming language, and an authoring system into one fast, free package (it comes with every Mac). To smooth the information path between HyperCard and the many Mac peripherals, Apple has announced the Apple Media Control Architecture (AMCA), a standard set of protocols and drivers.

Apple has also looked beyond Macintosh desktop multimedia to the Knowl-

dge Navigator. The Navigator, which is not a reality yet, will be a portable computer that will combine multimedia databases with artificially intelligent agents. An agent could search through incoming and stored information and select nuggets of interest to the individual user, using previous inquiries and work as a guide.

**Processors and Peripherals**

The two main members of the Mac family that apply in the multimedia arena are the Mac SE and the Mac II. The same 68030 processor now powers the latest system in each line that can directly address 8 megabytes of RAM (something a PC or PS/2 can do only under OS/2). The larger differences between the Macs now lie in expandability and display ability.

The Mac II line can accommodate color displays, with 8-bit or 24-bit color supplied by add-in-video-adaptor boards. (The Mac IIci 8-bit color video is part of the main processor board.) Mac IIs can show 256 colors from a palette of 16 million with 8-bit adapters. The 24-bit adapters actually use 32 bits—24 bits for the full 16 million colors and 8 bits for overlay details. (Support for 32-bit color was added to the Macintosh System software in 1989.)

Macs drive multiscreen monitors with analog RGB inputs. To synchronize RGB with video, you need an encoder to combine the RGB components and convert the scan rate by adding synchronization pulses. Genlocking cards and digital-video-effects cards are available. A range of add-in boards and peripherals gives the Mac more video power.

For example, Mass Microsystems Color Space FX can capture and modify color video images. Aapp’s Micro TV can show monochrome motion video in a window on the Mac screen. And Apple actually produced a video-overlay card for the Apple II line in early 1989, before making any such move for the Mac. The $549 Apple II Video Overlay Card is a
genlock for the Ile and IIGS.

The Mac clearly has enough color and, if you want to spend the money, enough resolution for multimedia work. It does not have dedicated graphics chips to speed up graphics processing, such as you'll find in the Commodore Amiga and some PC graphics boards, but there's a reason for that. All graphics are run through the System software's QuickDraw routines. In late 1989, several firms, including Radius, announced add-in coprocessor boards to accelerate QuickDraw.

Apple has yet to develop a data compression/decompression technology for video data. The company is looking to future high-speed, broadband networks for exchanging video information and "symmetrical" video compression so that the Mac can handle both sides of the work. Its Advanced Technology Group has been producing prototypes for such compression. This symmetry is important to Apple's multimedia plans. Unlike the IBM/Intel strategy that sees a big market for canned presentations and productions created and compressed by a larger computer system, Apple places more emphasis on the ability of users to create and edit their own productions.

The Mac display is not interlaced, which makes it difficult to convert to video. For instance, you can't just alternate lines into one of the two fields of a video frame, because what falls into the fields isn't consistent: The picture flickers and jumps.

To compete with the sound hardware of an Amiga, the Mac must call on peripheral add-ins. Apple offers a MIDI output option for the Mac that attaches to a serial port. You can also find third-party add-ons for sound, such as Farallon's MacRecorder, that can capture and digitize sound for use in other applications.

Apple's own CD-SC is a compression/decompression technology for video data. This symmetry is important to Apple's multimedia plans. Unlike the IBM/Intel strategy that sees a big market for canned presentations and productions created and compressed by a larger computer system, Apple places more emphasis on the ability of users to create and edit their own productions.

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The new Audio media add-on board and HyperCard-compatible software package from Digidesign can add 16-bit, CD-quality audio, including voice, music, and sound effects, to multimedia productions. More experimental peripherals include The Voice Navigator from Articulate Systems, a voice-recognition system that you can use in place of a mouse or keyboard, and MidiDancer, an experimental system developed at the California Institute of the Arts in Valencia. MidiDancer is a package of position sensors, radio transmitters, radio receiver, and MIDI instruments that sense motion and convert it into music.

Stacks for Macs

The Mac OS and HyperCard are the heart and soul of Macintosh multimedia. The operating system itself, along with the Finder and MultiFinder interfaces, provides a graphical display and an environment in which programs can swap data. In addition, it includes some useful tidbits, such as the MacinTalk driver, in which any program can call on to synthesize speech through the Mac's built-in speaker.

Version 7.0, scheduled for release this year, will add an Interapplication Communications Architecture facility to allow programs to actively share information. In multimedia, this facility could help to tie disparate applications into one production.

HyperCard was the first hypermedia program to receive widespread attention. It can be used to run multimedia productions, to customize them, or to build them from scratch. The individual logical "cards," on which HyperCard stores its information and links, are gathered into "stacks." These stacks can include information from many media. They can also use external links—XCMDs—to reach out to other applications and peripherals. (XCMD stands for external command, a term in the English-like HyperTalk scripting language. It is implemented in C or Pascal and adds two functions to HyperCard.)

Although its database is not sophisticated, HyperCard is compatible with just about all the Mac data formats. Successive versions of HyperCard have been graced by direct links to optical scanners and CD-ROM drives. The Apple Programmers and Developers Association has a videodisk drive set of HyperCard XCMDs. The Voyager Corp. has similar toolkits for controlling videodisks and CDs (audio and ROM).

HyperCard's popularity has even prompted the development of some compatible packages, such as Silicon Beach's SuperCard, that add features such as color. At Fall Comdex 1989, Spinnaker introduced Plus, a toolkit that runs on the Mac, Windows 3.0, and PM. Plus can access HyperCard stacks from the IBM or the Mac.

Apple is currently working to define the AMCA, a system-level architecture or framework for accessing information from videodisks, CD audio disks, and videotapes. AMCA could rescue software developers from having to write custom drivers for each multimedia peripheral. The specifications for AMCA are still in the brain-storming stage according to Apple, but will be issued as a kit with sample device drivers and user-interface guidelines for writing new drivers when they are ready.

Various application programs for the Mac are useful for multimedia. To create the elements of multimedia, there are drawing and modeling tools, from the original MacPaint and MacDraw to Electronic Arts's Studio/8 with its sophisticated color mixing and special effects. Paracomp's Swivel 3D creates hinged and jointed three-dimensional figures for animation. Farallon Computing's MacRecorder and ScreenRecorder capture sound and moving screen images, respectively, and play them back from inside a HyperCard stack.

For video manipulations, Avid Technology has a video editing system that runs on a Mac II. It digitizes and compresses video for real-time editing, losing quality but gaining interactivity. When the edit is complete, it can be used as a basis for actually editing tape—such as by Mac-controlled dual tape decks.

Then, there are the "authoring" programs, which connect and combine various clips of sound, graphics, and video. American Intellware has Storyboarder, which produces black-and-white animated storyboards from MacPaint images. MediaMaker from the BBC's Interactive Television Unit was developed in collaboration with Apple's Multimedia Lab. It can sequence up to 10 minutes of graphics, video, and CD audio using graphical "icons" to represent the elements. You can play and edit the icons using traditional Macintosh point-and-click operations. Also available are Course of Action and Authorware Professional from Authorware, and others.

The premier authoring package for the Mac outside of HyperCard, however, is probably MacroMind's Director. The successor to VideoWorks II, Director uses a metaphor of actors and a "score." It can create text, sound, graphics, and animation or import them. The score is time-based, dictating which elements happen and in what order. You can call Director from HyperCard and play its productions with the MacroMind Player, which comes free with Director. An advanced package called Director Interactive Toolkit combines Director with a HyperTalk-like language.

Cautiously Optimistic

Apple has identified multimedia as an education, training, and presentation market where it has the lead over IBM by a couple of laps: the Mac's graphical nature and HyperCard's quick adaptability continued
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to authoring. Apple is unlike Commodore, which pushes the current video abilities of the Amiga, and IBM and Intel, which talk about video presentations compressed off-line and then played back in real time. Apple spends more time talking about the future and "symmetrical" data compression that will allow you to create and edit multimedia presentations on the Mac.

Apple has an active Multimedia Lab, it publishes a catalog of development tools (Wings for the Mind) and a guide to courseware authoring, and it is working with developers to establish driver standards and an operating-system foundation that can support real-time video editing in the future.

Although it's already advertising the Mac's multimedia strengths, Apple is moving somewhat cautiously into the market.

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**IBM/INTEL**

**DVI and Full-Motion Video**

People are accustomed to watching full-motion video from broadcasts or VCR tapes. The restriction of many multimedia systems to partial-screen video or still images is immediately apparent. Even video-oriented computers, such as the Amiga, don't handle full-motion video on their own screens as digital information. The best they can do is to overlay their own graphics on top of full-motion video that remains in analog form, recorded on a tape.

To actually edit the video signal in real time, a computer must read, display, and store many megabytes of data every second. Microcomputers don't have the processing power for this. For example, a typical CD-ROM disk can store 74 minutes of audio, but only 90 seconds or so of video, and it cannot send a full 30 frames per second of full-screen, full-motion video data to the computer. Instead, it might send only a few frames per second, yielding a jerky, unrealistic motion picture.

This problem has two solutions. One is to speed up the computers and increase their storage capacity. This trend is already part of computing, but it's not enough. To handle full-motion video in real time as digital information, computers also need compression and de-compression. They need to cut down on the size of video images and files by intelligently eliminating redundant information.

IBM and Intel have a technology that promises to do exactly that: DVI (digital video interactive). Although it's still in development, DVI, or a compression technology similar to it, may affect every multimedia system in the mid to late 1990s.

**Not a Natural**

The IBM PC and PS/2s are not as suited to audio and video work as the Mac or the Amiga. They do offer more processing power, however, with 33-MHz 80386 and 20-MHz 80486 machines available from dozens of firms. The PS/2 line did jump to higher resolution and color with the VGA and 8514/A display adapters. And there are scores of specialty video adaptor cards from other companies, some offering graphics coprocessors for fast, high-resolution displays.

On the software side, the PC has some weapons, too. Although the original DOS is not oriented to graphics and doesn't have a standard graphics file format, Microsoft's Windows add-on is and does. So does the Mac interface for OS/2, which brings multitasking, access to 16 megabytes of RAM (DOS is limited to 640K bytes), interprocess communications, windows, and icons. (Windows 3.0 may bring some of these same benefits to DOS users.) There are also audio add-ons for PCs and compatibles, from MIDI cards to digitizers.

Even without multimedia-quality built-in hardware, the PC and PS/2 families have staked out some multimedia territory. Their popularity has seeded the largest third-party software and hardware add-on market for any computer. For example, Video Charley is a $750 genlock, encoder, and character generator from Progressive Image Technology. Truevision makes a variety of "Targa" boards for video capture and editing. Willow Peripherals makes VGA-TV, a VGA card that can convert VGA output to NTSC video to show VGA presentations on a TV or record them on standard videotape. At Fall Comdex 1989, VideoLogic showed its DVA-4000 digital video adapter board, which supports VGA graphics and real-time manipulation of moving video images. Logos Systems International announced the DoubleTake AV audio/video digitizer, an add-in board that can digitize NTSC, PAL, or SECAM (the TV standard in France and the U.S.S.R.) video still images and can also digitize and compress audio input with 7-bit resolution.

Most of the programmable videodisk players in the U.S. are hooked up to controlling IBM PCs or compatibles. IBM's InfoWindow is a popular authoring program for such videodisk systems. The PC can also run Owl's Guide, a hypermedia program with windows, graphics, and limited animation. And Intel has announced an authoring package, called Authology: Multimedia, designed exclusively for DVI.

IBM's Audio Visual Connection program runs on PS/2s with video-capture and audio-adapter cards from IBM. AVC runs under either DOS or OS/2. It can capture and edit sound and images and add special effects to build presentations. Using IBM's KnowledgeTool expert-system package, AVC can call on other applications.

Spinnaker's new hypermedia toolkit, Plus, runs under OS/2 and Windows 3.0, as well as on the Mac. It promises to access HyperCard stacks from IBM or Mac versions. Autodesk, home of the dominant PC CAD program, AutoCAD, has a new, inexpensive animation program called Autodesk Animator. It has tweening (automatic shape transformation), pathing, and other sophisticated animation routines. Microsoft has created a new division just for multimedia publishing. Through DOS, a PC can use CD-ROMs, and Microsoft and IBM have endorsed CD-ROM XA.

**Squeezably Snug**

But the real news for the PC is DVI. Invented by General Electric and RCA (now the property of Intel), DVI is a compression/decompression scheme that can squeeze video files to 1 percent of their original size. That means you can have an hour of digital, full-screen, full-motion (30 frames per second) video on a single, standard CD-ROM disk. (DVI can also squeeze audio files.) You can then display that motion video on the PC screen, and combine it there with text and graphics. The resulting video doesn't have all the quality of the original (it smear colors somewhat and loses some focus), but no other technology yet comes close for putting full-screen, full-motion video on a PC.

DVI is the work of a pair of chips: the i750 chip set. One is the 82750PA Pixel Processor, a 12.5-million-instruction-per-second chip (an AT runs at about 2 MIPS) with its own parallel-processing architecture and on-chip RAM for quick reprogramming. The other chip is the 82750DA Output Display Processor, which can serve up several different resolutions, from 256 by 200 pixels to 1024 by 512 pixels in 8-, 16-, or 24-bit color.
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SONY/PHILIPS

CD-I and Optical Disks

The high-quality audio and video files of multimedia work can be enormous. To store them, you will need to rely on optical storage. Two of the leaders in optical storage are Sony and Philips, companies that also have a large share of the world’s consumer electronics market.

Sony and Philips are approaching multimedia from three directions. First, they are working with IBM, Apple, Commodoore, and other computer companies to provide the optical disk drives necessary for multimedia systems. Second, they are pursuing compact disk interactive (CD-I), a technology that could provide multimedia without a computer. Third, they are exploring how new audio, video, and computer technologies will blend with consumer electronics to create new markets such as video conferencing.

CDs Take Over the World

Lasers can read and write vast amounts of data because they can focus on minute areas of a disk or tape. Sony and Philips came up with the CD—a 12-centimeter-diameter optical disk that can store information as tiny pits on a rotating surface. If the information is in the form of music, the disk is called a CD-DA (digital audio) and can play up to 74 minutes of high-quality sound. (CD-DA player and disk prices fell quickly; after just a few years, they have driven vinyl LPs nearly out of the market.)

If the same disk is used to store the bits of computer data—programs, text, and graphics—it’s called a CD-ROM. CD-ROMs can pack about 550 megabytes of data, many times what a conventional hard disk can hold, although it’s also much slower to find and read that information than on a hard disk. (A CD-ROM has an access time of about 1 second instead of the hard disk’s approximately 20 milliseconds.)

With the right physical connection (through a SCSI or serial port) and file format, operating-system drivers (which both DOS and the Mac OS have), and relevant applications (to search through, read, and display the data), you can use CD-ROMs with almost any computer. The data can be text, numbers, graphics, or anything else a computer understands.

The physical format for the disk is set out in the Philips and Sony “Yellow Book.” (A “Red Book” covers CD-DA.) The logical-file standard format is the High Sierra Group ISO 9660 standard. A newer CD-ROM XA standard adds interleaved audio and video to CD-ROM.

CD-ROMs are relatively cheap to reproduce at a stamping plant, but the individual computer can’t write to them. Thus, they make a good publishing medium, but they don’t work as a replacement for magnetic disk drives. There are WORM (write once, read many times) continued
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and fully erasable optical disk drives are available, too, from firms such as Sony and Philips, but the disks hold less than CD-ROMs (about 200 megabytes compared to 550 megabytes) and are much more expensive than CD-ROM drives.

Forget the Computer?
Both Sony and Philips have a direct interest in systems that combine computers and optical disks. Philips has a division called Headstart Technologies that claims "the first line of personal computers with a built-in CD-ROM drive and CD software" at a consumer price—under $2000. Sony makes a computer-laser disk training system that's similar to IBM's InfoWindow packages.

But Sony and Philips don't think every multimedia application needs a full-blown computer. The CD-I standard, described in the "Green Book," lays out a plan for a low-cost, independent CD player. (There's also another format called CD-V, which puts five minutes of TV-style video on a CD, playable only by CD laser disk drives.)

The CD-I player, or "decoder," could be used at home just as a VCR or video game is today, and wouldn't demand a computer or the training that most computers require. The disk format would be compatible with the High Sierra Scheme, but it would have more detail. It would be aimed at a specific 68000 microprocessor-based decoder running the CDRTOS operating system and relying on at least 1 megabyte of RAM and custom VLSI video and audio processors. RTOS is descended from OS-9, a multitasking operating system that was used in the Tandy Color Computer and some industrial systems.

The decoder wouldn't necessarily have a keyboard and would interface to a monitor or to a standard TV. It would provide four different sound modes, with a range of quality and memory demands, and five video modes, with a range of colors, resolutions, and memory demands. Full-screen, full-motion video performance is ruled out by the data rate from the CD-I disk and the lack of hardware to decompress images in real time.

For instance, the RL (run-length) mode uses highly compressed images but can reproduce only 10 frames per second with 128 colors. Changes to these modes in future CD-I systems would require changes to the custom VLSI chips. The interactive nature of the system would allow you to play games, answer questions, and otherwise react to and influence the sequence of images and sounds from the disk and decoder.

Only Time Will Tell
Philips, Sony, and Matsushita (for the video processing) have all worked on CD-I's development. The several hundred companies that have licensed CDDA automatically have a license to use CD-I, and many firms have produced CD-I prototype titles that combine sound, voice, still pictures, cartoons, text, and partial-screen motion video.

No one knows yet whether CD-I will capture a large market. If it does, the CD-ROM XA standard will allow you to read both CD-ROM and CD-I disks if you are willing to upgrade your CD-ROM drives. The lack of full-motion video in CD-I is lamented by some who see compression technologies like DVI forcing CD-I off-track within a couple of years. Either way, Sony and Philips are sure to sell lots of optical disk drives.

Four Roads Met in a Wood
Multimedia definitions run from combining text, sound, and animation on-screen to full digital video for editing and storage.

For Commodore, multimedia is a graphically potent, video-compatible architecture that is backed up by a multitasking operating system and topped off with a thorough and easily understood authoring system.

For Apple, it's the next step after desktop publishing and presentations, using HyperCard and some new peripheral control standards to tie together a variety of interactive graphics, sound programs, and peripherals.

For IBM and Intel, multimedia begins with today's authoring software and laser disks and moves toward a future of full-screen, full-motion digital video through DVI compression technology.

For Sony and Philips, multimedia is the convergence of consumer electronics, communications, and computers. It represents the certainty of selling optical disks, and the possibility of creating a new market with CD-I.

As processors get faster and capacity grows, microcomputers will grow more capable of multimedia. For now, the big names are taking different paths.
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Multimedia—the synthesis of interactive computers with full-motion video and compact-disk-quality sound—may transform the way you use computers. Then again, it may be just a fad, like Pong. Some call multimedia the “next revolution in microcomputers”; others describe its market potential as “dazzling” and “explosive.”

A recent Business Week article claims that “the biggest names in computing—and some in television, too—are agog” over the prospect of a colossal multimedia market. One computer consulting firm, Information Workstation Group, predicts a $17 billion market for multimedia by 1994. Yet Steve Jobs, computer pioneer and founder of NeXT, warns that multimedia may become the “artificial intelligence” of the 1990s—that is, a new technology without a commercial home.

Truth and Beauty
As usual, when hysteria and hype outpace the facts, the truth lies somewhere in between. Multimedia may become the technological darling of the 1990s. If it does, it will be through evolution rather than revolution. Beyond the hype (and the skepticism) are four fundamental principles that must be considered when forecasting the future of multimedia and planning multimedia strategies. The first two I classify as “truths” about multimedia; the latter two encompass the “beauty” of this technology:

- **Utility.** The key to the success of multimedia; it has to be a technology that provides solutions.
- **Incrementalism.** Market growth will be mainly incremental, taking place in measured, sequential stages instead of revolutionary leaps and bounds.
- **New markets.** Multimedia will allow microcomputers to reach new groups of users by helping to remove the inherent complexities of using more powerful applications.
- **Information appliances.** Personal computers will become as simple to use—and as widespread—as, for example, TV sets. In turn, this expanded base of microcomputers will form the basis for whole new categories of applications and appeal to a whole new class of users.

First and Foremost
The advancement of hardware technology is certainly central to the success of multimedia. However, application developers must keep their feet on the ground and concentrate their efforts on delivering real utility.

As is the case with AI, multimedia will rarely if ever be the primary selling feature for computer applications. Instead, it will be embedded, in increasing...
Avoiding the Pitfalls
Pat Maupin

One of the primary business uses of multimedia to date has been training. I’ve seen some very good applications of multimedia for training—and some very bad ones. The good ones range from slick, sophisticated presentations down to fairly crude programs that aren’t much more than computer-controlled videotapes. The bad ones cover the same ground.

What’s the difference? Usually, the bad ones exhibit a misuse of the technology, caused by a misunderstanding of what it’s actually good for and how it can benefit the application. This misuse is most often caused by pushing technology for technology’s sake and rushing headlong to be at the forefront without stopping to analyze exactly what it is and what it does. Here are some of the problems.

Grasping Its Limitations
Some subjects and teaching methods are much more amenable to multimedia than others. Multimedia is a good tool for teaching basic familiarity with almost any subject in an informal way. It can also be good at “what if” educational scenarios, where you can make decisions and then see the results of those decisions.

One of the real benefits of multimedia is that you can’t take a multimedia course passively. You must interact with it, and the direction and depth of the course change with that interaction. Another real benefit is that you can easily gear the pace of the course to match a student’s capabilities.

For some subjects, multimedia actually seems to be the best teaching method available. For others, it can deliver a course that is “almost as good” as alternative teaching methods that may be prohibitively expensive (e.g., Tank Driving 101 or Nuclear Power Plant Operations 203). You can usually achieve a good, cost-effective balance with the proper mixture of multimedia and live practice.

Bad applications can result, however, when you use multimedia as the primary (rather than supplemental) teaching method for courses covering complex subject matter. Multimedia can work well for multiple choice tests, but it can’t grade an essay. And you can’t expect all the students to have the typing skills necessary to compose an essay on-line.

Applying Its Capabilities
Because of the mad rush to become involved with the technology, not only is multimedia sometimes used for things it shouldn’t be, but sometimes the things it can do are ignored or missed. For example, whether you’re working with a CD or a laser disk, some information is processed at production time and some when the course is actually run. Proper partitioning of this information is critical to developing a successful, cost-effective course.

Too often, information is processed at the wrong time. Fades, which the computer can handle very easily, are frequently etched into the laser disk, wasting valuable audio and video time. I have seen a screen full of “buttons” for touch screens etched into a videodisk, with one frame for all buttons off, and a separate frame highlighting each button in its activated state. Sometimes this is done for nonoverlay systems or for an aesthetic effect with very nice buttons.

However, this particular course was authored for an overlay system, designed to take advantage of graphics over video. And the buttons weren’t all that great. The authors spent a lot of money on video production to put the buttons there. They also needed to write code to make the laser disk player seek to highlight the correct button. This task isn’t really any easier than using a graphics library to reshare the button. And if any changes were necessary after production, they’d have to use computer graphics to modify the button screen, anyway.

Information is often processed late that should have been included at production time. One of the great things about multimedia is that you can fix a lot of problems post-production. After spending thousands of dollars producing video and audio, companies tend to treat the CD or laser disk as difficult and expensive-to-change hardware, while the programmers, as is frequently the case, must modify their software to fix the hardware.

Unfortunately, in some cases, the ability to fix and enhance after the fact is abused. This happens for several reasons: time and budget pressures, lack of planning, or even lack of confidence that the information is correct and pertinent. Whatever the reason, it’s a waste to distribute a course on a laser disk that isn’t even half full along with over 2 megabytes of .PCX files that will never change. These files could have contained prettier pictures and been drawn faster if they had been created on the laser disk initially.

Enough Is Enough
Some courses go overboard with flashy displays and sounds that actually detract from the point they’re trying to make. Everyone has seen computer programs where the fancy user interface actually

degrees of integration (and inspiration), in future generations of applications. Eventually, multimedia capabilities will be sprinkled through almost all layers of software, offering new interfaces, new business applications, redefined programming tools, and possibly even new operating systems.

As an example, consider how utility is moving the personal computer industry from the traditional character-based user interfaces to the now-popular graphical user interfaces, with their windows, icons, mice, and pull-down menus. It’s not just that GUls are more fun to use; they are being adopted where they can make you more productive and will eventually become standard features in new applications.

With the advent of multimedia, I predict that we will have a third interface: the video user interface. Windows will be filled with stills and motion video, high-resolution icons will become animated graphics, and audio will be a standard accompaniment to text.

As for programmer’s tools and operating systems, multimedia-assisted tools will prove to be as helpful to program developers as interfaces will be to end users. Object-oriented programming will grow to include more media-rich objects; programming tools will offer diagrammatic control of code. Here again, utility will pay off in programmer productivity.
Lotus's first multimedia "product" is an example of how the first stage of commercialization addresses the first question: "Why should I buy this application?" It is called MM3D (Multimedia release 3 demonstration). It is a powerful demo for Lotus 1-2-3 release 3.0.

In convincing you to buy a software product, the seller has maybe 30 seconds to present its case and hook you. Multimedia can pack that 30 seconds with a dazzling sales presentation.

The 30-minute, CD-based MM3D program is fully interactive, allowing you to select which 30 seconds you wish to see next. It uses screen shots, audio, graphics, and video stills to demonstrate, animate, and explain features and benefits of Lotus 1-2-3 release 3.0. MM3D is being used at trade shows, in dealer showrooms, and in sales training. If the first use for multimedia is for selling application programs, the next one is for training new users.

Up to Speed
Training is a major expense for corporations. As a result, application developers are constantly working to reduce the amount of time and money customers spend beyond the selling price of the software—thus reducing the "real" cost of a product. An issue today, training will be even more important in the future, as applications become more and more complex. (See the text box "Avoiding the Pitfalls.")

Multimedia is a natural for initial training, providing a level of interaction and feedback not possible with a paper manual. Beyond initial training, multimedia Help functions will be closely integrated with applications, simulating instructors who can guide you through the application via voice output. "Just in time" (JIT) learning will prove far more effective than today's too-often frustrating Help features and documentation.

In fact, JIT learning will also be helpful to people besides users. Most of us know a coworker who is the de facto software expert. If you're stuck, you simply call the expert and say, "Hey Ed, how do I get to such and such a screen?" I do it; everyone does it. And it works well.

The trouble is, Ed is usually getting paid for more than just giving advice, and so these questions place a serious imposition on his time. When a multimedia Help facility can finally take Ed's place, Ed will be able to do the work he gets paid for, and the company will benefit.

Multimedia Platforms
Today, multimedia simply refers to a range of capabilities that include interactive digital audio and video and are usually delivered on CD-ROM.

To run a basic multimedia program today, you can use an 80386 with a VGA monitor and a CD-ROM reader, along with an additional high-quality audio speaker or two. This setup—which I call a "premium vanilla" platform—will do a respectable job of mixing high-quality audio and color video together as a kind of"
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**BEYOND HYPE**

In the future, multimedia will benefit from an expanding suite of capabilities, thanks to coming hardware developments in data-processing and compression technology.

**New Flavors**

The key performance-limiting item for multimedia is the bandwidth between the CPU/main memory and external storage. Full-range audio gobbles megabytes of data, as does full-motion color video. Providing interactivity compounds the problem of shipping data back and forth between main memory and disk.

Beyond the premium vanilla platform, the first major development will be the use of digital signal processing (DSP) chips to permit interleaving of full-range audio with text and image data. The most promising format is known as CD-ROM-XA (extended architecture), which was jointly announced by Philips, Sony, and Microsoft in September 1988.

The second development concerns video compression. The data space that is needed for full-motion, full-screen, full-resolution video is much too large to allow it to be stored, moved, and displayed easily. Therefore, each image must be compressed. Many companies (from giants such as Philips and Apple to tiny C-Cube, to name a few) are developing similar kinds of technologies that will soon be reduced to silicon.

Most promising is a hardware-based technology called DVI (for digital video interactive) that can compress video data by a factor of more than 100 and play it back in real time. DVI is owned by Intel, and IBM has already announced plans to market it.

I expect it will be possible to buy a CD-ROM-XA-equipped PC or an upgrade board sometime in the next 18 months, and a DVI-equipped machine or replacement board perhaps six to 18 months after that.

**New Markets**

DSP and video compression will help remove the technological barriers to multimedia advancement and will help pave the way to the third multimedia principle—opening new markets. You will be getting greater utility from multimedia-aided applications; therefore, software developers should have a somewhat easier time selling the next generation of products.

For instance, it is a disconcerting fact that as applications become more complex and powerful, use of their features tends to decrease. The multimedia bene-

fits mentioned earlier—in training and Help systems—are intended to stimulate the use of complex features.

In fact, within the next five years, I predict that customers will have the opportunity to buy most of the popular PC applications with all the built-in training a person new to computers will need to use them efficiently.

In the long run, this will make it easier to sell—and to buy—much more powerful applications. It will make it easier to identify and explore entirely new product concepts and market ideas. As multimedia functions become more closely integrated with the sales, training, and Help aspects of programs, you will get more out of your applications and spend less time on learning curves.

**Information Appliances**

Sometime after the next wave of standards in hardware and software has settled, the PC will become an “information appliance.” By combining the power of sophisticated audio, video, and computing technology with the ease-of-use of a toaster, multimedia will capture a significant number of new users and will go beyond office desktops and into homes and schools.

As we combine multimedia with some aspects of expert systems and advanced circuit technology, the result may be a “gestural” interface, one that can understand a nod or shake of your head or a movement of your hand.

Applications will also progress—permitting, for instance, the integration of audio and high-resolution video into PC presentations, E-mail, workgroup tasks, and personal information managers.

Most important, multimedia—which today is hardly more than a set of technical attributes—will dramatically enrich the quality of personal and business communications. It promises to be nothing less than a paradigm shift.

Sounds wonderful, doesn’t it? What can go wrong? Plenty. If you put the hype before the work and worship at the altar of technology and potential, you can miss the point. It will take all the parts of the formula—technologies, applications, and real, cost-effective utility—before multimedia can begin to deliver some of what it now only promises.

Rob Lippincott is director of business development for the information services group of Lotus Development Corp. (Cambridge, MA). Previously, he worked on interactive technologies for WGBH-TV (Boston, MA). He can be reached on BIX c/o “editors.”
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Birth of the BLOB

Multimedia databases will radically change the way you look at and work with information

Tim Shetler

There's a revolution afoot. It's called multimedia, and it's changing your databases. In fact, it will completely revise the way you store, access, and manipulate information. In conjunction with windowed graphical interfaces, image scanners, optical character recognition devices, mass storage devices such as optical disks, and other advanced technologies, multimedia opens the door to a revolution in corporate computing.

Multimedia databases can handle more than character fields. They can also store scanned forms and photos, text documents, program source code and object modules, spreadsheets, and digitized voice. In fact, multimedia databases can manage just about any object that you can store on a computer or use in an application.

The Theory of Relativity
An expansion on the usual relational database, a multimedia database is capable of storing large, unstructured data objects as just another field in a database record. The standardization of the structured query language for DBMS applications makes it imperative that you be able to create and manipulate objects for multimedia databases through extensions to standard SQL.

As with any other data type, these objects are considered part of an atomic unit of work (i.e., a transaction), and they are archived, restored, and recovered through the normal mechanisms that the DBMS supplies. A multimedia database application can present you with any combination of data fields, images, and text objects. It can even capture voice or sound as an object and “display” it back to you through a speaker.

This form of multimedia database uses a new category of data types, called binary large objects (BLOBs), to define those fields in a record that will contain the objects. The two BLOB data types are text and byte.

Text BLOBs contain valid text characters, such as memos, chapters of a manual, contracts, and source code. Byte BLOBs are binary data streams that can contain any object, such as a spreadsheet, graph, fax, object-code module, satellite data, voice pattern, or any digitized data.

Since a BLOB could be very large (up to 2 gigabytes), a multimedia database must allow you to place the entire BLOB column—relational databases define information in terms of rows and columns—on a separate partition of a disk, or on its own magnetic or optical disk. The term blobspace denotes a logical region of the database that contains columns of BLOBs. A blobspace can be located on any device or

ILLUSTRATION: ROBERT TINNEY © 1990
across multiple devices. When a BLOB column is placed in the blobspace, the corresponding field in the record will point to its location.

The location of the BLOB is transparent to an application, just as the locations of all the other data fields in a relational database are. The ability to store a BLOB in a location that is separate from the record that contains it offers two benefits. First, it ensures that you can still perform high-volume applications without large objects at optimal speeds. Second, it lets you use low-cost storage media to store BLOBs.

Mix and Match
Multimedia databases open up a much wider world of application opportunities, particularly for those whose operations are based on documents or drawings. Insurers, financial institutions, regulatory agencies, parts distributors, libraries, transportation companies, legal institutions, and research centers can all automate large portions of their businesses with this technology.

Some companies could change the entire nature of their operations with a multimedia database and affect significant cost savings. Realtors, for example, could take clients on a tour of homes without ever leaving the office. You could scrutinize photos, floor plans, and area maps and eliminate undesirable properties without having to visit each house.

Not only is a multimedia database able to store and protect these objects, but the indexing ability inherent in a DBMS enables you to locate them immediately. Since an object is presented as just another data field in a database record, you can query all the other fields in that record that are not objects through SQL’s search facilities. Once the search is complete and has returned one or more records that match the search criteria, then you can access the object fields. By contrast, stand-alone graphics or word processing applications store information only by the name of the object and provide no other way to locate it. In multimedia databases, full SQL text retrieval, which allows indexing into text objects based on significant words or word combinations, extends this indexing power even further.

A multimedia database is not the same as an object-oriented database, however. In general, multimedia databases are designed for applications where including some objects, such as drawings or contracts, adds substantial value.

Object-oriented databases, on the other hand, consist almost entirely of objects, and they support a variety of complex relationships among them. Although multimedia databases can implement some relationships between objects or support objects that have a greater degree of self-definition, they are more general-purpose than their object-oriented cousins.

The ACID Test
You have to implement a multimedia DBMS so that a BLOB column looks the same as any other data type would—that is, like a regular field. This leads to a great many design issues, primarily because of the potentially large size of the BLOBs.

DBMSes are designed to guarantee that all transactions adhere to the ACID properties: atomicity, consistency, isolation, and durability. Atomicity requires that either all or none of the changes made during a transaction be reflected in the database. This means that if a transaction is in progress when a system failure occurs, none of the changes that the transaction made before the failure should remain in the database after system recovery. If, however, the transaction completed before the system failure occurred, all its changes should be present after recovery.

Consistency requires that processing transactions take the database from one consistent state to another, insofar as other users are concerned. You aren’t allowed to see an inconsistent database; that is, you don’t see the changes made by an in-process transaction until that transaction completes.

Isolation requires that the effects of a transaction in a multiuser environment be the same as they would be if that transaction were run on a single-user environment. If you read all the personnel records for a specific department, for example, other users should not be allowed to add or delete records for that department until you have completed your transaction.

Consistency and isolation are achieved through a variety of locking techniques. Since a BLOB is simply another field in a database record, you lock BLOBs in much the same way that you lock other fields. When a row is locked, access to the BLOB is also locked.

Finally, durability requires that a database system ensure that once a transaction completes, its changes must be permanently reflected in the database even after subsequent system and media failures. Durability is usually accomplished with a rollback recovery mechanism and either roll-forward recovery or mirroring, or both.

Most DBMSes use similar locking, logging, and recovery processes to guarantee the ACID properties. In a multimedia DBMS, however, these processes must be modified to handle potentially large objects efficiently. In addition, archiving operations and the use of memory and disk space also require special handling.

Log Rolling and Recovery
Because a BLOB can be very large, the usual logging and recovery processes aren’t practical in a multimedia database. For instance, if a transaction inserted several large BLOBs into the database, an extremely large log file would be necessary to hold these insertions. In addition, since logging operations are often buffered in memory until a transaction commits, logging a large BLOB could cause frequent flushing of the buffer and result in substantial performance degradation.

For these reasons, the BLOB itself is not logged. Instead, when you modify or insert a BLOB, the change is written directly to the database at that time. In addition, when you modify or delete a BLOB, the old image is not overwritten. A free-space map tracks the blobspace as it is used or freed up.

The ability to roll back the change is still guaranteed, however, because the space that the old BLOB occupied is locked for the duration of the transaction, and the changes to the space map and the record containing the BLOB are logged. If you need to perform a rollback, the free-space map is restored so that the pages in the blobspace where the change was written are once again marked as free, and the record that contains the BLOB once again points to the prior occurrence of the BLOB (after rolling back updates and deletions), or is removed entirely (after rolling back insertions).

Roll-forward recovery is also slightly different in a multimedia database. It is normally supported by periodically archiving the log to tape. However, since BLOB changes aren’t logged, the archiving process must be modified.

When the log is archived to tape, the archive process locates all the instances where a BLOB was modified or inserted, and retrieves that BLOB from the database at that time. Before you can reuse a BLOB page, you must have written it to the log on tape.

Thus, the archiving process is certain to find the BLOB when it attempts to

continued
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IN DEPTH

BIRTH OF THE BLOB

Listing 1: This is a sample of an embedded SQL for a C program that reads a scanned photo from a multimedia database. (The definition of the locator structure itself has been omitted.)

```c
Schar name[20];
Sstruct locator photo;
photo.loc_locmemory=locmemory;
SELECT name, photo from employees
INTO $name, $photo
WHERE empno=125;
```

archive it. Throughout this process, all the changes to the database, including BLOBs, are logged on the roll-forward tape, without requiring the BLOBs to be logged to disk.

**In the Archives**

Periodically, you should archive every database to establish a fallback point in case of a catastrophic system failure. Usually, archiving is performed so that a roll-forward recovery can occur after a media failure. Disk mirroring solves the media failure problem, but archiving is still prudent in case data becomes corrupted through an error or a breakdown in security.

In a multimedia database with many BLOB occurrences, the database or a single table could be enormous, so that a full archive of the database could take hours. Such a DBMS should provide an on-line archiving mechanism so the data can be archived while the system is still in use. However, since BLOBs tend to be static in nature, an incremental archiving capability that backs up only the changes to the database or a blob-space is more practical. This type of archiving can be performed while the system is still running through an error or a breakdown in security.

For example, if a blobspace will hold a drawing that is, on average, 7K bytes to 8K bytes in size, you can set the page size for its blobspace to 8K bytes; then you need only a single I/O request for each read or write. Also, since a program can act on an object as it is stored and retrieved from the database, you could employ user-written routines to compress and decompress a BLOB and substantially reduce the disk space required to store the BLOBs.

**SQL for BLOBs**

The SQL statements SELECT, UPDATE, INSERT, and DELETE can access a BLOB that’s stored in a multimedia database. However, because a BLOB isn’t a single value, like an integer, using these SQL statements is more restricted. You can’t use BLOB data items in arithmetic, string, or Boolean expressions (except to see if a BLOB is equal to null). Also, you can’t reference BLOB fields with clauses, like GROUP BY and ORDER BY, or with qualifiers, such as DISTINCT and UNIQUE. These options don’t make sense with a BLOB.

Most often, applications insert and retrieve BLOBs from the database and display them in conjunction with other data fields from the same record. Updates to BLOBs are less likely to occur unless the BLOB contains a text document or a spreadsheet.

When a C program accesses a BLOB, a locator structure manages the location of the BLOB. The object isn’t stored

continued
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in the structure itself; rather, it is stored in memory or in a file, and the locator structure references it. This structure contains fields for the return status of BLOB operations, the type of BLOB (i.e., text or byte), the size of the object, its location, and so on.

In listing 1, the database engine reads photo into a location in memory and returns locator information into the structure. The program can then display the BLOB, edit it in some fashion, or pass it to another program. If the database engine reads photo into a system file, the program simply indicates the filename in the locator structure prior to the SELECT. Then the engine places photo into the file instead of into memory. Using a fourth-generation programming language, you can read a BLOB into a defined field in the program in the same way that you would read in any other variable.

A BLOB is never extracted from the database until the application specifically references it. If a SQL operation requires searching through several pages of a table, for instance, and a BLOB column is defined in that table, the BLOBs will not be read into memory at the time that the operation searches the pages. Instead, a pointer to the appropriate BLOB will be read in with each record. Then, when the program specifically requests a BLOB from one of the records, the object will be read into memory or into a file at that time.

Thus, the presence of BLOBs in a table doesn’t affect the performance of the operation. It operates as if there were no objects in the database at all.

On the Evolution Spiral

As multimedia database systems evolve, locating and processing objects will be refined and made easier. Relationships between different objects could be supported, as in an object-oriented database system. In addition to a full text-retrieval capability accessible via extended SQL, it may be possible to perform searches through byte objects.

For example, you might write a function that searches through a specific graphics format and determines whether a particular company logo is included in the picture. Then, you could store that function in the database engine and perform a SQL request that will locate all the pictures in the database with the same logo in them.

There are many possibilities for extending multimedia database technologies in various directions for use in commercial applications. As users begin to use the power that these capabilities provide, the potential will become more evident and products will evolve. Multimedia databases will have a profound impact on how companies do business in the future.

Editor’s note: Informix Software, Inc. (Menlo Park, CA), has introduced Informix-OnLine, a database engine that supports multimedia database applications and fault-tolerant on-line transaction processing. A Unix-based relational DBMS, OnLine can store SQL-accessible documents, spreadsheets, graphs, faxes, images, and voice information up to 2 gigabytes in size as objects in a regular field in a database record.

Tim Shetler is a product marketing manager for the advanced products division of Informix Software, Inc. (Menlo Park, CA). He can be reached on BIX c/o "editors."

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Desktop Video Studio

Use this emerging technology to wow them at your next presentation

Rick Cook

Just as desktop publishing puts the equivalent of a page layout and print shop on your desk, desktop video can give you the equivalent of a video studio at your fingertips. It is simple enough to learn and cheap enough that you can afford to play with it until you get something you like. While there is a learning curve (you must become familiar with a new technology) and the final product won't be as good as a first-class professionally created video, desktop video will be more than adequate for many applications.

What's It Good For?
In general, any kind of presentation that moves is a candidate for desktop video (see the photo on page 230). One common use is in professional video production. A lot of video makers and video studios have recognized that desktop video can save them time and money. Commercials, trailers (those short movie previews), and TV shows use it. In fact, there's an excellent chance that the lines and arrows on the weather maps on your TV news were produced with a desktop-video system. (For an actual application of a desktop-video system, see the text box “Tethered Satellites Made Easy” on page 233.)

However, most users of desktop video are people who have realized that it can give them advantages in conveying information to peers, supervisors, clients, and others. Architects can take clients on tours of buildings before they are built and show how new construction will fit on a proposed site. Planners can show how buildings will affect flight paths at airports. Attorneys use video presentations to present evidence and show judges and juries their versions of what happened. Engineers and scientists use desktop video as a powerful alternative to conventional presentations of dynamic systems, especially complex ones.

The Process
Most desktop video involves two basic operations: overlay and animation. Overlay means putting a computer-generated image on top of an image from a camera or on videotape. This is most commonly used to superimpose titles or animation over a live-action picture.

Overlaying an image requires a device called a genlock to synchronize the computer's output with the video signal. More sophisticated genlocks have controls to fade images in and out, enabling you to produce simple special effects. Technically, genlocking refers only to synchronizing the signals. In practice, in desktop video, a “genlock” refers to a combination genlock and encoder.

An encoder converts the RGB output from a computer into a U.S.-standard continued
National Television System Committee (NTSC) composite video signal that your TV can transmit and your VCR can record. If you don't need the overlay capability, a video encoder can substitute for a genlock. While you can't overlay an image on existing video with it, you can put the computer output on tape. However, the overlay capability of a genlock is preferable.

Animation involves making a series of images, each slightly different from the last, and displaying them in succession so rapidly that they appear to show motion. Usually, it requires at least 25 frames (images) per second; 50 to 60 is better for smoother animation. Consequently, it takes many frames to produce even a short animation.

Desktop-video workstations need lots of memory and disk space to deal with this requirement. Not only does the finished product take up a lot of memory, but animations are usually built in small sections and spliced together. Even with a good animation package, there is a certain amount of cut-and-try, which usually requires keeping several versions of a sequence on disk.

Although you can create animation with almost any draw or paint program, or even CAD software, the trend is toward specialized animation programs. At their most elementary, animation programs can define several frames at once, copy parts of images from one frame to another, and display the sequence. Almost all of them let you define a complex object as a "brush" and move it as a unit, and most of them can do more complicated things, too.

Animation programs are usually also paint programs. You can use them to create images, as well as to manipulate those images already on the screen. Most of them can also import images from other programs. For example, you might bring a CAD image into an animation program and color, shade, and animate it to show what the object would look like in motion.

Functionally, you can divide paint and animation programs into two-dimensional and three-dimensional classes. A two-dimensional program creates and manipulates what are essentially flat objects, while a three-dimensional program builds up solid models and works with them. Frequently, three-dimensional programs are able to use ray tracing or other sophisticated rendering techniques to make the results look more real. But you sacrifice some computing power and ease of use.

There are all kinds of subtleties in a satisfying animation. For example, an object dropped from the top of the screen should move slowly at first and then pick up speed as "gravity" accelerates it. Thus, the images of the object need to be close together on the early frames and to move farther apart in the later ones. When an object like a ball bounces off a surface, it deforms and then regains its original shape. Some animation programs automate these processes.

Three Architectures
Although a great deal of computer video is done on workstations from companies such as Sun Microsystems and Silicon Graphics, most desktop video is done on Amigas, MS-DOS machines, and Macintosh IIIs. All three have different strengths and weaknesses as desktop-video machines.

The easiest microcomputer to use as a video workstation is probably the Commodore Amiga. It was designed for graphics and video compatibility, and there is a large selection of inexpensive video hardware and software for it.

Like a TV, but unlike most computers, the Amiga has an interface mode in which each screen is composed of two frames containing alternating scan lines. Also, the Amigas sold in the U.S. have a horizontal scan frequency of 15,750 Hz, the same as the NTSC TV standard. These features make it easier and cheaper to build genlocks and other video equipment for the Amiga. The Amiga also has an overscan mode, which extends the picture beyond the edge of the screen. This eliminates the border around a conventional computer-generated image when it is displayed on videotape.

The Amiga 2000 and 2500 have two video outputs, one for analog RGB signals and the other for the digital signals before they are converted to analog. The RGB port is preferred for monitors and less expensive video equipment, while the digital video slot is used with high-quality equipment.

One nice thing about Amiga software is that it tends to consider the inexperienced user. Many of the animation, paint, and titling programs have user-friendly interfaces and fairly easy-to-understand manuals. Because Amigas have been widely used for video since they first appeared, the software is somewhat more advanced than that available on other two architectures.

The major drawback to the Amiga is that it runs out of headroom at about the point where professional video quality starts. Although some Amiga models have slots, the machine's display processing is done by a custom VLSI chip set on the motherboard. Those chips limit the number of colors and resolution available. They also limit the display memory to 1 megabyte, although the Amiga can have up to 9 megabytes of RAM.

The basic Amiga display is limited to 640- by 480-pixel resolution (704 by 480 pixels using overscan) and 32 colors. Continued
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The Amiga has a couple of special modes called half-bright and HAM [hold and modify] that can display up to 64 and 4096 colors, respectively, but these have limitations. In half-bright mode, 32 of the colors are half-intensity shades of the other 32. In HAM mode, it can take as many as 3 pixels to go from one color to another. Several companies, including Commodore, are working on high-resolution video boards for the Amiga based on the Texas Instruments 340x0 family of graphics processors and the INMOS transputer RISC processor. These video boards will offer more resolution and more colors than are currently available.

If the Amiga has the architecture best suited to desktop video, the IBM PC and its compatibles probably have the worst. The combination of limited display adapters and a segmented processor architecture make the stock AT a poor choice for high-quality graphics work. But, unlike the Amiga, MS-DOS and OS/2 machines are easy to upgrade. Video-compatible display cards, math coprocessors, and faster 80286 and 80386 processors can turn a PC into a powerful and effective video workstation. In fact, PCs are numerically the most popular machines for desktop video today.

Because MS-DOS is the dominant microcomputer architecture and companies have been producing high-resolution video cards for MS-DOS machines, there are several options for desktop video on DOS systems. The most common video standard for MS-DOS desktop video is probably VGA. The hardware is relatively inexpensive, the 640 by 480-pixel resolution and 256-color palette are adequate, and a lot of computers are sold with VGA capability. A number of VGA boards now come with an NTSC output jack to put images directly onto videotape.

Besides VGA, several other display boards offer even higher resolutions and more colors. Boards from companies like Truevision can provide over 16 million colors at resolutions of 512 by 482 pixels and higher. Some of the boards double as frame grabbers and can digitize a picture from a video camera or videotape for computer manipulation.

Although some of these boards have been available for several years, desktop-video software for nonprofessionals started to arrive only in the last year or two. For example, last year, Autodesk announced its Animator program, offering animation at 320- by 200-pixel resolution with 256 colors for $299.

The Mac II is the latest microcomputer family to enter the desktop-video business. The original Macintoshes with monochrome displays and no expansion slots weren’t suitable for desktop video, but the Mac II family is, and a number of manufacturers have introduced video products for it.

Another major factor is Apple’s 32-Bit Color QuickDraw, introduced last year. It provides a standard programming interface for color graphics applications with 24-bit color (16.7 million shades) and an 8-bit alpha channel. The alpha channel can be used for special effects such as setting the transparency level.

Several companies have come out with sophisticated animation and rendering programs for the Mac II, including Super 3D from Silicon Beach Software and Swivel 3D from Paracomp. Byte by Byte has brought a version of its Sculpt-Animal 4D to the Mac from the Amiga.

Apple’s main focus for desktop video is as part of multimedia presentations. Apple has paid a lot of attention to integrating video with HyperCard and other presentation products. Thus, Apple has a compact disk player for the Mac, but it doesn’t offer a genlock. Genlocks are available from third parties, however.

What Do You Need?
The general rule is: The more memory the better for video applications. The absolute minimum is 1 megabyte; 4 to 8 megabytes is better. Likewise, a computer used for video work needs a powerful processor and a math coprocessor, if possible. Going from a 68000 to a 68030 can reduce the time needed to process an image by a factor of eight or more. In the MS-DOS world, an 80286 system is the slowest one recommended; a 33-MHz 80386 is preferred. Finally, you should have a large, fast hard disk drive. An 80-megabyte unit with a 28-millisecond or less seek time is good, and people who do a lot of video work use 150- or 300-megabyte hard disk drives.

If the video is going to be put on tape, you need video equipment as well. At a minimum, this means a VCR, something capable of genlocking the computer to a VCR, and a way to produce NTSC output. Although any VCR capable of recording can be used for desktop video, some features are especially useful. One is “flying” erase heads for cleaner edits. Another is the ability to connect to an external video editor. An accurate frame counter is also useful. Overlays and editing require two VCRs; three are preferable.

A good-quality encoder or combination encoder/genlock is also important.

The genlock’s performance is critical to the quality of the finished tape, so most desktop-video makers advise getting the best one you can afford. Unlike film, which is edited by cutting and splicing, video is usually edited by rerecording onto another tape. An edit controller is very useful for making seamless cuts in editing and generally making editing faster and easier. Another useful device is a switcher for switching among the computer, the VCR, and other signal sources. Finally, you need a camera setup to record video in the first place. In addition to a video camera or camcorder, this setup should include lights, lenses, and other equipment.

A complete set of equipment like this is expensive and probably overkill for a lot of desktop-video jobs. Many desktop videos have been done with just a VCR, a genlock, and a computer.

But How Good Is It?
The standard for comparison in video work is “broadcast quality”—images with the sharpness, clarity, and purity of color found on major network broadcasts. Like desktop publishing’s “typeset quality,” broadcast quality is a nebulous term signifying some truly professional standard of output. Desktop video does not measure up to such a standard any more than desktop publishing does.

The quality of desktop video can be good, but for a variety of reasons, it will never be as good as what a studio full of professional equipment will produce. Most of these reasons are in the hardware, but users do some things that make the problems worse, such as using saturated colors that smear, high-contrast colors with borders that “crawl,” and thin, 1-pixel-thick lines that flicker. You have to learn some techniques to get the best from your system.

Choosing the right tape format also minimizes troubles. Few of us have access to the expensive 1-inch reel-to-reel videotape machines used by large broadcast studios, or even the ¼-inch tape used in many newsrooms. VHS is much more common, but it produces only fair recording quality. The recently introduced Super VHS gives measurably better quality.

As in the photographic process, every generation away from the original suffers from degradation. The 1-inch tape and the equipment that uses it are of very high quality and introduce very little distortion during subsequent copying. Even when a tape is originally recorded in VHS format, if you copy it to ¼-inch or 1-inch tape and do the production work
Tethered Satellites Made Easy

For David Lang, desktop video is a standard tool. Lang, who runs his own consulting company out of Mercer Island, Washington, is a specialist in tethered satellites (two or more satellites joined by a cable). He wrote a program called the Tethered Orbiting Satellite Simulator, or TOSS, which calculates and displays the motions of tethered-satellite systems (see the photo at right).

For a variety of reasons, this is an area of considerable interest to NASA and companies involved in the space program. But it's not an easy one to understand. By their nature, tethered satellites are dynamic. Their motions are complex and sometimes counterintuitive. The usual way to describe the dynamics of tethered satellites is with systems of equations. While this is accurate, it is meaningless to anyone who doesn't understand the mathematics. But if you can see the motion of the satellites, what is happening becomes fairly obvious. You may not gain as much knowledge as you would if you studied the equations, but for a nonspecialist, this method is often adequate.

Lang's first desktop video came about when he was asked to do a tape for an open house at Johnson Space Center showing some of the basics of tethered-satellite systems. Lang had no previous video-production experience. But he had a Macintosh II, and he knew where he could get a genlock board for his machine.

"The whole thing was pretty much a low-budget operation," Lang said. "I did the animation, the narration, the video production, dubbed in the music, the entire deal." The result was "Tethers for Novices," a videotape that shows what happens when you tie two orbiting objects together. Over background music, the narrator describes how tethered objects interact. On the screen, a space shuttle reels a satellite in and out while the earth spins below.

Lang used Super 3D from Silicon Beach Software to create the animation. His TOSS program provided the basic motion of the shuttle, tether, and satellite, and he did the images of the parts with Super 3D. "The solid models of the shuttle and the space station I got from the Design Edge people in Houston," he said. He imported the models into Super 3D to be animated.

Starting with the earth, Lang had a globe painted to resemble the planet and taped that while it was spinning. He used that tape as a background and overlaid the animation using the genlock.

The cost of the equipment was fairly low. "The software was $250 list; the genlock board was on the order of $1100 or $1200," Lang said. "Then I used a standard VHS VCR. The only other thing I had to get was a Tascan Porta II audio mixer for about $400."

"The biggest expense by far was a 300-megabyte hard drive. In order to do an effective presentation, you want to have enough hard disk capacity laying around so you can keep a number of animations at your fingertips when you start the production process."

However, the process was time-consuming. "It probably took a couple of months to write the code to take the data out of the tether simulation and put it in the form Super 3D wanted to see," he said. "Once it was in motion, it took just a few hours to create the animation."

The result was so successful that Lang used video animation to present the result of an engineering study to NASA. "For complex dynamic motion, animation can show you things you couldn't possibly describe otherwise," he said.

The NTSC standard is just over 35 years old. It is an analog standard, and everything is held together by a precisely timed sequence of synchronizing pulses in the signal. When color TV became available in the 1950s, the standard was modified to allow compatible color—continued
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In Depth
Desktop Video Studio

Desktop video is still in its infancy. Desktop publishing took off not with the invention of the laser printer, which made the technology possible, but with the release of the Macintosh and the Apple LaserWriter printer, which made it easy. Today, desktop-video technology is possible, but it's not yet easy. It's still waiting for its equivalent of the Mac.

Probably the biggest need is to integrate the systems and make them easier to use. The individual components, especially the software, are powerful and fairly easy to use, but the overall process isn't; you may need half a dozen programs to do one presentation. In particular, the video transfer and editing need to be made easier. Ideally, you should be able to plug a video camera and recorder into a computer and turn out images as easily as you turn out laser-printed pages today.

Some progress has occurred in that direction, however. There is a strong trend toward standardization in file formats for video software. For example, most Amiga programs, except those for three-dimensional modeling, use a standard file format, called IFF, for graphical images. This standard makes it easy to move an image back and forth among Amiga applications and use each program to do whatever part of the task it is best suited to. Similar standards or quasi-standards exist for the Macintosh and MS-DOS machines.

A number of companies, especially in the Amiga market, are working on video authoring systems to make the whole process easier. The aim of these programs is to give users a consistent interface for managing text, graphics, and audio. At least some of the Amiga programs should be out now.

One particularly interesting product is from the BBC. MediaMaker is for the Macintosh and works with 8-mm videotape to let you define key frames in your video, graphics, and sound sequences and designate each key frame and the attached sequence with an icon. Then you can edit the presentation by manipulating icons in typical Macintosh fashion.

The hardware is improving as well. Genlocks and editors are getting better, if not necessarily cheaper. New formats, like Super VHS, offer better picture quality at lower prices. And video equipment manufacturers are adding features to make their products more useful for amateur and desktop-video production.

Desktop video may never be as widespread as desktop publishing. But as we move from computer graphics into multimedia, it seems certain to become more popular. Desktop video is a powerful tool for communications of all kinds.

Rick Cook is a freelance writer in Phoenix, Arizona, specializing in computers and high-technology subjects. He can be reached on BIX as "rcook."
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Multimedia Makers Mentioned

The number of companies working in multimedia and related fields is enormous. It includes those involved in graphics software and hardware, animation, speech synthesis, music, video boards, genlocks, CD-ROMs, video cameras, videodisk players, and more. Therefore, of necessity, this listing contains only those companies mentioned in the various articles in this In Depth section.

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The Art of Ray Tracing

Generating realistic 3-D images is a natural for the parallel-processing power of transputers

Owen F. Ransen

The earliest three-dimensional computer graphics were simple wire frames—stick-figure representations of the real world. Then, in 1968, a researcher named Arthur Appel published a paper on ray tracing—a three-dimensional-rendering technique to reproduce realistic shadows, reflections, and refractions.

Working at the IBM Research Center at Yorktown Heights, New York, Appel improved on simple wire-frame drawings by hiding invisible lines and adding shading and shadows. The technique made solids appear more solid and gave a better idea of the relative three-dimensional position of objects.

Early images were black and white, but researchers soon realized that ray tracing could also render reflections and transparency, and in full color (see photos 1 and 2).

Apart from creating interesting pictures, ray tracing can be used to perform volume calculations and optics simulations, and to represent fields in physics simulations. Photo 3 shows an industrial application that helps the user select the colors of plastic extrusions.

Catching Rays

Basic ray tracing is actually very simple. Instead of thinking of a traditional camera where light enters a lens and hits film, think of a computer simulating a camera that sends rays from the film out into the world. Imagine lines from the center of each pixel passing through an imaginary lens (usually a pinhole) and out into space (see figure 1). If the ray hits an object, the pixel where the ray originated takes on the color of that object. The place (in $x,y,z$ coordinates) where the ray hits the object is called the ray-object intersection. If the ray hits an object with a shiny surface, you can calculate the reflected ray and see if it hits a second object. If the second ray (the reflected ray) hits a second object, you can see a reflection of the second object in the first.

To produce realistic and accurate shadows, ray tracing uses shadow rays. A shadow ray is a straight line drawn from a point on a specific object to the light source. If the line reaches the light source without hitting an intervening object first, then the original point is not in shadow.

The problem with ray tracing is the amount of time it takes. An image of 512 by 512 pixels requires that at least 262,144 pixels be calculated, and antialiasing (a process that smooths jagged edges in computer-generated images) requires even more than that. In spite of much fruitful research into developing fast ray-tracing algo-
rithms, rendering currently takes hours per image.

Fortunately, ray tracing lends itself to the sort of parallel processing supported by the transputer, a family of processors designed and manufactured by INMOS for parallel-processing applications.

### Parallelism and Transputers

The top of the transputer line is the INMOS T800, a single chip containing a 32-bit microprocessor, an FPU, four communications links, 4K bytes of fast internal static RAM, and a memory interface that can address up to 4 gigabytes of external RAM. It was designed specifically for multiprocessor systems. (See "T800 and Counting," November 1988 BYTE.)

One of the simplest transputers is the T212, with a 16-bit processor, 2K bytes of internal RAM, and four communications links. The T212 can access up to 64K bytes of external memory. The T414 has no FPU and only 2K bytes of internal RAM but is otherwise identical to the T800. Transputers also come in application-specific varieties, such as the M212, which has extra hardware to deal with disk drives. Any type of transputer can communicate with any other type using the communications links.

A single transputer can run two or more parallel processes. This internal parallelism allows the FPU and the CPU to work on separate data at the same time and allows the four communications links to run independently of the FPU and CPU. It also features hardware support for multitasking as well as multiprocessing so that several processes can run simultaneously on a single transputer.

This internal parallelism allows buffers to be created in software. They act very much like a buffer in a printer. One transputer can send another transputer a message over the links, much as you can send a long file to a printer. If the printer has a large buffer, you can download the whole of the file into it and carry on with another job while the printer prints out the file. If a receiving transputer has internal buffers, the sending transputer can transmit its message quickly and get on with its job, even though the receiving transputer may not be ready to react to the message.

The links enable external parallelism—the ability for two or more transputers to work simultaneously on the same problem. External parallelism allows hundreds and thousands of transputers to be connected simply and efficiently. Each T800 has four links, which allow it to be connected directly to four other transputers. Thus, you can make pipelines, rings, and square arrays. Each link runs at 20 megabits per second and is bidirectional.

### Ray Tracing and Transputers

Transputer systems are flexible in the way that they implement parallelism. The most popular technique is the "farm" method. Each transputer has the same program but runs with different data. When the transputer has finished its job, it sends back the results and starts work on new data. A main controlling processor (often a transputer, too) organizes the sending of jobs and reception of results.

Figure 2 shows a layout with some transputers connected in a ring configuration. The lines between each transputer represent the communications links. Photos 1 and 2 were generated using a ring of 16 transputers connected as shown in figure 2. In a typical transputer-based ray-tracing system, the IBM PC contains an IMS B004 board (or compatible) used for the Transputer Development System. A ring-controller transputer allocates jobs to, and receives replies from, the transputers in the ring. The replies are usually graphics data to plot on the graphics board. Within each ring transputer, two parallel processes run—one handles command and result routing, and the other does the actual ray tracing (see figure 3).

For ray-tracing applications, you can get each transputer to work on a single pixel. This method is acceptable but carries with it a high communications overhead. If the screen size is 512 by 512 pixels, then 262,144 job messages and 262,144 result messages have to be handled.

You must also consider antialiasing problems when organizing and distributing the jobs. Usually, you use antialiasing only where absolutely necessary—that is, where jagged edges would be most visible. To know where to do the antialiasing, the transputer must have knowledge of the pixels above and below (and to the left and right of) the pixel it is currently working on. A transputer working on a single pixel at a time does not know anything about surrounding pixels.

If, instead of giving each transputer a single pixel to work on, you give it a whole row of pixels—a scan line—then you can greatly reduce the communications overhead. An image of 512 by 512 pixels is made up of 512 scan lines of 512 pixels each.

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**Photo 2:** By distorting the field of the soft objects using rotation and stretching, you can create any number of smooth, streamlined shapes, such as the spaceship seen here.
Linearity refers to the relationship between number of processors and speed. A perfectly linear system with 16 processors will complete a job 16 times faster than a single-processor system.

Thus, instead of a command and reply for every pixel (262,144 messages per image), you have a command and a reply for every scan line (512 messages per image).

A typical command sent from the controlling transputer around the ring would look like this (in plain English): "Transputer number 9, ray-trace the scan line at y = 100." A typical reply sent back to the controller would be, "This is a message from transputer number 12. I have worked out scan line 133; here it is. Now I am free to accept another job."

There's still a problem with antialiasing, though. Each transputer can perform antialiasing in the horizontal direction because it has a whole scan line of the image and so knows the color of the pixels to the left and right of the current one. It does not know, however, the color of the pixels above and below it. They are in separate scan lines, being calculated by other transputers. You can resolve this by getting each transputer to work on a subscreen—a small rectangular area of the main screen. Most pixels in a subscreen have neighbors in the same subscreen, so the transputer can antialias them. Pixels on the edge of the subscreen may require extra work to antialias properly.

If your images are part of a sequence for computer animation, another obvious way to distribute the tasks is to hand each transputer a single frame. The problem here is that each frame will take a different amount of time to calculate, and there's no guarantee that the first frame of the video will be completed first. In animations I created, I divided the image into a 16 by 16 grid, with 16 transputers sharing the 256 separate subscreens. On average, each transputer would calculate 16 subscreens. Obviously, however, some subscreens take longer than others; an area of the image where there are no objects will not take as long as an area where there is a silver spaceship, for example. This imbalance in the time a transputer takes to complete a subscreen can be quite a problem.

If 15 transputers have finished their jobs and are all waiting for the sixteenth transputer to complete its final subscreen, those 15 idle transputers are wasted. When I created an animation, I overcame this by getting the controlling transputer to predict where the image would take the longest to calculate. The master transputer records the time it takes to complete each subscreen and notes the parts of the screen that require a greater effort. On subsequent frames, the calculation starts on these "difficult" subscreens first. This method takes advantage of the fact that in a sequence of images for animation, there is usually little difference between one image and the next in the location of difficult areas. Thus, as the animation progresses, the master transputer can easily track the areas of difficulty.

Speed and Linearity
In parallel-processing systems, linearity refers to the relationship between the number of processors and the speed of the system. A perfectly linear system of 16 processors will complete a given job 16 times faster than a single-processor system (see table 1). Losses in linearity usually occur because of interprocessor communications overhead. The transputer's communications links operate in parallel with the processor, so this overhead is very low.

With 16 T414s arranged in a ring, it took about 25 minutes to calculate the image shown in photo 1. (The T800 is about eight times faster on floating-point calculations, but it was not available when the test was carried out.) The image size is 512 by 512 pixels and includes antialiasing, shadows, and reflections.

I worked out the linearity of the system by timing it with the same image on different sizes of rings. As you can see from table 1, the linearity is very good (even up to 16 transputers, it is within 1 percent of perfect linearity).
Occam vs. C
Many people are waiting for C compilers before using the transputer. This is justified when you are porting software. But for creating new programs, you may want to consider Occam. It offers a simple, secure way to do parallel programming. (See “Configuring Parallel Programs, Part 2,” January BYTE.)

No programming language is perfect, and Occam’s most obvious drawback is that recursion is not possible. Further, it allocates memory statically (e.g., there is no Occam version of C’s malloc). Static memory allocation is not a problem if you want to build secure systems. You’ll never run out of memory at run time. If you can live without recursion, you may find Occam a useful high-level language. I made the images in this article using programs written entirely in Occam.

Occam Constructs Used in Ray Tracing
Figure 3 shows the internal software structure of the ring components. There are two parallel processes—a router and a ray tracer. These parallel processes are not hard-wired in the transputer but are created by the program. The router takes in commands and data from LinkOin, looks at each command, and decides if the message is for its own transputer. All the transputers have unique identifiers, and the routers know what identifier their transputer has. Then the command is passed down to the ray tracer. If the command is for another transputer, or if it is a data packet (a subscreen completed by another transputer), the router passes the packet out to LinklOut. In this way, there is a flow of commands and subscreens around the ring.

Since the transputer’s links run independently of the processor itself, this constant flow of data only minimally slows down the processing. When there are 16 transputers in the ring, each transputer has to handle not only its own packets but also the packets of the other 15 transputers that pass through it. Table 1 shows that this overhead accounts for less than 1 percent of the total processing time. The longest possible message in this application is a single subscreen 3072 bytes long (32 pixels wide by 32 pixels deep by 3 bytes per pixel), plus a few bytes of control and address information.

The transputer is more efficient with long messages than short messages because the main overhead in message passing is getting the link hardware running. Once the transputer has started the link, though, its operation interferes very little with the processor. Here is the Occam for the ring component:

CHAN OF RtCommands In, Out:
PLACE In AT LinkOin:
PLACE Out AT LinklOut:
CHAN OF RtCommands FromRT, ToRT:

PAR
  router (In, ToRT, FromRT, Out)
  tracer (ToRT, FromRT)

An Occam channel is the software equivalent of a transputer link. CHAN OF RtCommands declares channels with a type, RtCommands, which is defined elsewhere as a protocol required for the ray-tracing commands and results. The channels In and Out are hard channels—where the two PLACE statements, they are actually mapped to the hardware of the transputer’s links.

The channels FromRT and ToRT are soft channels and are used for communication between processes within a single processor. PAR means “run the following (indented) processes in parallel.” So router and tracer are two processes that run in parallel and communicate using two soft channels. These two continued
The Art of Ray Tracing

Consider the following:

WHILE TRUE
ALT
  In ? command
  ...process the command...
  ...send command down to tracer or...
  FromRT ? subscreen
Out ! subscreen

There are two components of this ALT. One starts with In ? command, the other with FromRT ? subscreen. The first component, channel ? x, means "input from channel to variable x"; the second part, channel ! x, means "send the value of x out of the channel." This fragment will input from the first channel, In or FromRT, to receive a message and then either process the command or output the variable subscreen. (Occam can output large arrays of data using a single statement.) The enclosing WHILE TRUE ensures that the ALT is repeated forever, constantly selecting from the two inputs.

Figure 3 shows that the two inputs to the router are from the ring (In) and the tracer (FromRT). The messages that come from the tracer are always subscreens, ready to be routed back to the master transputer and displayed. The messages coming from the ring are commands or subscreens computed by other transputers. Obviously, you don't know the timing of the messages, and this is where ALT shows its usefulnes. It helps handle indeterminacy. For a more detailed explanation of the latest version of Occam, see "Occam II," October 1989 BYTE.

Hardware Simplicity and Power

There are now processors that offer roughly the same performance as a single T800 transputer. What they do not offer, however, is the simplicity of design and unlimited expansion of processing power. Communication between transputers is via two wires and a ground plane. The external clock for any number of transputers is a single 5-MHz crystal.

The hardware design does not change if the system has 10 or 100 transputers (apart from the power supply, of course). The transputer's internal RAM and the loading of programs via link means that you can easily debug transputer boards. As long as the transputer chip itself, the power supply, and the clock are all working, you can run a test program on internal RAM and use it to debug the external components.

When INMOS created the transputer, it created a Pandora's box of complexities that needed to be addressed before the transputer could take off on its own. At first, there was no floating-point capability, the parts didn't work, deliveries were a problem, and there was no software. Most of those problems have been solved.

Then INMOS created Occam, which does a good job of utilizing the computing model of the transputer. But mainly because of the difficulty of making users appreciate the language's unique capabilities for synchronizing processes and for interprocessor communication. So that hurdle isn't much of a barrier anymore.

Since the development of ray tracing, there has been a need for algorithms that will speed up the process. Researchers have made progress in this area. Ray tracing is easily distributable on multiprocessor networks. It has potential for some industrial applications and for anyone who needs to follow rays of light through complete optical systems.

Today, there are even some very inexpensive ray-tracing programs (under $100) with which high-school students can experiment. Thus, now that the pieces are in place to perform ray tracing on personal computers, it takes little imagination to see how you can use ray tracing to visualize real three-dimensional fields.

FOR FURTHER READING


Owen F. Ransen is a transputer consultant in Milan, Italy. He can be reached on BIX c/o "Editors."
Goscript is a software-driven postscript interpreter that works on most dot matrix, laser and ink jet printers. Fonts can be scaled to any size and rotated to any angle. Goscript works with directly with Ventura, Wordperfect, PageMaker as well as other programs. Goscript has 13 fonts. Goscript Plus has 35 fonts compatible with the Apple LaserWriter fonts.
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MICRO EDSELS

A look back at 15 years of the good, the bad, and the marketing bombs of the microcomputer revolution

Kenneth M. Sheldon

It has been called the most expensive flop in automotive history, the triumph of market research over changing consumer tastes, Dearborn's million-dollar baby. It was the Ford Edsel.

Several years and hundreds of millions of dollars in the making, the Edsel was released in 1958. The Edsel had distinctive styling, such as a grill that some said looked like a horse collar and futuristic gadgetry including "Teletouch" automatic transmission with push buttons in the center of the steering wheel.

Unfortunately, 1958 was a recession year, and compact cars were just catching on. After three years of intense marketing and meager sales, Ford had sold fewer than 30,000 of the cars—barely 10 percent of what it had hoped to sell. The word Edsel became synonymous with "commercial fiasco."

Of course, those of us in the computer field have to be careful when it comes to throwing stones at the Edsel. We have our own memorable mistakes to keep us humble—systems that were highly touted, long-anticipated, and now long-gone.

But not forgotten. Herewith, we present a nostalgic look at some of the fabulous flops of the computer industry that we've covered over the past 15 years.

Apple Crumble

Apple Computer, the company that led the microcomputer revolution, also provided the first major casualty. When Apple realized that many people were buying the popular Apple II for small businesses, the company threw all its efforts into a new, improved system aimed specifically at the business market—the Apple III. In spite of the company's efforts, however, the...
Apple III shipped late and experienced what cofounder Steve Wozniak called a "100 percent failure rate." While Apple promoted its new business machine, it hobbled the Apple II so that it wouldn't compete with the Apple III. Unfortunately, the stunted Apple II also couldn't compete with the IBM PC, which promptly took over as the top-selling microcomputer. The Apple III dropped from sight shortly thereafter.

Having ceded the first round to IBM, Apple took a different tack. With advanced technology borrowed from the Xerox Palo Alto Research Center, it released the Lisa, the first commercial system to feature windows, icons, pull-down menus, and a mouse. At $10,000, the Lisa was the DeLorean of the computer world, and few people could afford it. When Apple later released the Macintosh, with similar features to the Lisa and a price tag that was affordable to mere mortals, Lisa's slim sales became anorexic. Apple eventually dropped the price of the system to $3995 and changed its name to the Macintosh XL—a bit like calling the DeLorean the "Mustang XL."

The tactic didn't work. Apple put Lisa out to pasture in the summer of 1985, and its successor went on to set records and sire numerous offspring.

Shakedown and Outs
Back when the first microcomputer operating systems were fighting it out for supremacy, several computer companies tried to cover their bets with systems that ran more than one operating system or used two different processors. The most interesting of these was the Dimension 68000 from Micro Craft. The Dimension was a be-all and end-all computer that would supposedly run Apple, IBM PC, TRS-80, CP/M, and Unix programs, using coprocessor cards. It didn't. The Dimension entered the Twilight Zone in October 1984 as Micro Craft entered Chapter 11.

Smelling gold in the microcomputer hills, everybody tried to get into the act. But for some reason, large companies (other than IBM) seemed congenitally unable to market a microcomputer successfully. Wang, Xerox, and Data General all tried and failed to make significant inroads into the IBM PC's territory. But the most memorable failure was the DEC Rainbow, which ran both MS-DOS and CP/M programs. When first shipped, however, the Rainbow wouldn't let you format disks—you had to buy them preformatted from Digital Equipment Corp.—a "feature" that cast a pall over the Rainbow from the start.

The Rainbow was especially interesting in light of a question asked by DEC president Ken Olsen in 1974: "Why would anyone need a computer of their own?" Apparently, consumers couldn't imagine why anyone would need an MS-DOS computer that wasn't compatible with the IBM PC; sales were underwhelming, and few were surprised when DEC ceased production of the Rainbow in February 1985.

After a while, IBM PC compatibility became the sine qua non of personal computers, and other computers had to have something special to set them apart. Enter the Mindset, a graphics-oriented semicompatible whose case was so unique that it was chosen for display in the Museum of Modern Art. In fact, it may be the only place that you can find one now, unless you happened to be at the auction at the Mindset headquarters,
when everything including the furniture was up for grabs. (Interestingly, the Mindset presaged two later systems that were heavily graphics-oriented: the Amiga and the Atari ST.)

### The Problems with Portables

While the GRiD Compass was the first true laptop computer, it was an expensive system sold mostly to government contracts (and now owned by Tandy). At the first Spring Comdex in 1983, a former president of Zilog took dozens of members of the press hostage for a tour of Atlanta, during which he unveiled the Gavilan computer, an affordable laptop with built-in software, an eight-line LCD screen, and a touchpad "mouse." In spite of massive media attention, Gavilan was never able to get its manufacturing act together, and the curtain came down on its mobile computer in the fall of 1984.

Of course, you didn't have to be a newcomer to stumble in the portable field. Adam Osborne, the man who invented the portable computer, scoffed at IBM's entry into personal computers. His company stayed on the sidelines while newer companies, such as Compaq, wrestled with the problems of PC compatibility. Osborne finally did announce a PC compatible called the Osborne III, along with the Vixen (a new version of the original Osborne I) but didn't ship them on time. Sales of the original Osborne portables plummeted as customers awaited the new models, and Osborne went under in September 1983. The company came up for air briefly but then sank from sight in 1984.

Oddly enough, even IBM had a hard time marketing a portable that was compatible with its popular PC. Remember the IBM PC Convertible and PC Portable? That's all right; neither does anyone else.

### Breaking into Homes

As noted in "A Report on the Consumer Electronics Show" in the September 1983 BYTE, "a single event dominated the show: the introduction of the Adam, Coleco's personal computer." Coleco, you will recall, marketed the phenomenally successful Cabbage Patch Kids. The Adam, with such features as a full-size keyboard, "digital data packs," two game controller units, bundled software, and a daisy-wheel printer—all for a price of $599—sent shivers through the ranks of other companies that were making or planning home computers. They warmed up, however, when reports of problems with Adam's tape drive, printer, and built-in software began pouring in. (The problems were later blamed on inadequate documentation and technical support.)

One of the companies spooked by Coleco's announcement was Texas Instruments, which had introduced the TI-99/4A in 1979 at a price of $1150. At that price, sales were sparse, and they weren't helped by an innovative marketing strategy that consisted of discouraging anyone else from creating software for the machine. When TI dropped the price to $150, sales of the TI-99/4A took off. Unfortunately, a dangerously flaky power supply squashed sales, just as the bottom was falling out of the mythical home computer market and dragging systems from Timex, Atari, Mattel, and others with it. TI eventually decided to give up on low-priced systems. Oddly, the orphan

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99/4A thereafter became a best-seller, with a street price of $49. A short time later, the Adam was also retired.

Of course, the demise of these systems was hastened by rumors that a killer home computer, compatible with the IBM PC, was about to emerge from the Big Blue womb—the PCjr.

Requiem for a Lightweight

It is perhaps fitting that the consummate micro Edsel was produced by the company that dominated the microcomputer world in the 1980s. The IBM PCjr, heir apparent to the IBM PC, was perhaps the most anticipated personal computer ever (only the Macintosh generated a similar amount of rumor and speculation prior to its release). The “Peanut” (as it was called during development) was IBM’s attempt to make a home computer that was compatible with the IBM PC but wouldn’t co-opt its sales. To that end, IBM hobbled the PCjr with a toy keyboard (which, nevertheless, featured an Edsel-like high-tech infrared keyboard connection), a single disk drive, and a maximum of 128K bytes of RAM. These “features” were designed to guarantee that no one would ever use it in an office.

As it turned out, not that many people wanted to use the PCjr at home, either. If you wanted a system to play games on, others were available at less cost and with more games. If you needed IBM PC compatibility, you could buy a fully equipped PC clone for less. And as for IBM’s attempt to sell the PCjr to the education market—well, if business belonged to Big Blue, education belonged to Apple; the PCjr barely got in the schoolhouse door.

IBM commenced damage control, substituting a genuine keyboard and lowering the price of the PCjr during the 1984 Christmas season. Sales quickly surged but came to a screeching halt when the discount ended.

In April 1985, IBM pulled the plug on the PCjr. When the press reported that IBM was abandoning the system, the company reacted defensively, noting in a Wall Street Journal ad that it had simply produced all the PCjrs that it needed (or would ever need, apparently).

Computer Collectibles

Space prohibits describing some of the other microcomputer misses of the past 15 years: the TI-99/2—produced, promoted, and withdrawn before it ever saw daylight; the Data General/One, first of the PC-compatible laptops, with a screen that was almost visible under certain conditions; the Spectravideo; the Workslate; the Jupiter; the Commuter; and dozens of others, gone now, except for occasional reappearances in discount catalogs and on home shopping programs.

In all fairness, many of the computers I’ve mentioned were actually very good machines, often attempting to blaze some new trail of features, technology, or price/performance ratio. Some of them were simply sunk by circumstances or mangled by marketing errors: the right machine at the wrong time—or from the wrong company.

So if you have one in your attic, don’t be too quick to discard it. Like the Edsel, it may be a collector’s item someday.

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STORAGE DIMENSIONS
DROWNING IN DATA

The gathering deluge of information calls for new approaches to data storage

Peter Vogelgesang

If recording devices had existed when Abraham Lincoln delivered the Gettysburg Address, his speech certainly would have been recorded for posterity. While Lincoln's speech required only 5 minutes to present, the person who spoke before him talked for an hour and a half—driving away half the audience before the president spoke. The half that left early simply could not endure the volume of words that preceded what they had come to hear.

That event of long ago typifies a problem of today—namely, what information is worth keeping, and what should be thrown away? Often, you don't understand the value of information until sometime in the future, so you must keep all of it in order to have the important stuff when you need it. For example, what airplane pilots and control-tower personnel say to each other is of lasting importance only on those few tragic occasions when an airplane goes down. The only way to ensure that those critical conversations will be preserved is to record everything.

The logical extension of that scheme—assigning a discrete recorder to every information source in the world—is a logistical impossibility. Developing an information classification system that facilitates rapid and accurate retrieval of so much stored information is equally impossible.

One way to acquire a large store of information without using a large number of recorders is to record a part of the electromagnetic spectrum. If you record antenna signals that cover the part of the spectrum most useful for communications (10 kHz to 200 MHz), then you capture long-wave communications, AM and FM radio, several TV channels, and emergency radio services. In the same way, you can also capture private telephone calls, radio teletype, aircraft and control-tower conversations, point-to-point communications, and every other kind of information that hits the airwaves. All this could be accessed on the basis of time of occurrence and the approximate geographical location of the signal sources.

You could record a sizable piece of the electromagnetic spectrum for a year (from an antenna at one point on earth) on an area of recording medium about the size of 36 city blocks. To put it another way, you would need 16 million 12-inch optical disks, which, if stacked vertically, would be 68,000 feet high. The same number of disks in 8-foot stacks would take up over 10,000 square feet of floor space, allowing a little extra for aisle access.

Three Major Concerns
There is nothing new about the increasing demands for continued
recording more and more on less and less (the ultimate consequence of which will be to record everything onto nothing). For the past 40 years, the recording industry has responded to this need by learning how to use a smaller area of a medium for recording each bit of information. Both magnetic and optical recording methods currently assign submicron dimensions to recorded bits. Regarding future recording systems, the three major concerns will be to increase the rate of writing and reading bits, increase the capacity to store bits, and access the recorded information faster.

Recording is a two-dimensional process—you record on surface areas. Thus, you must scan across the areas, either by moving the recording transducers relative to the medium, or moving the medium relative to the transducers, or both. The ultimate limit regarding how fast you can record and read data is established by how fast you can move these elements. Some digital recorders are already moving rotating heads at a hundred miles an hour over a tape surface. It is unlikely that data transfer rates will be increased by further increasing the speed of media and transducers.

You can, though, boost the capacity of a recorder either by writing smaller bits (which are already submicron) or by using more surface area. However, as you increase the surface area, the time required to access a specific point on this larger area also increases, so it takes longer to retrieve information. Thus, the rate, capacity, and access time tend to be mutually exclusive.

One answer to this dilemma is to record simultaneously on different parts of a surface. This approach increases the recording rate by the number of parts employed. The head wheel of a high-performance helical-scan magnetic tape recorder can contain a number of heads that are simultaneously in contact with the tape and that write and read data in parallel. The recorder's data rate, of course, is increased in proportion to the number of heads used. Tracks are written as interleaved diagonal paths having lengths equal to the circumference of the head wheel. Scanning the tape in this manner requires mechanisms of great precision. The tracks, which are only one one-thousandth of an inch wide, must be written precisely adjacent to each other without overlapping or having excessive space between them. Then, during playback, the heads must follow the same tracks with no deviation exceeding about 10 percent of the track width, or one ten-thousandth of an inch. The unit must maintain this precision on a flexible tape that is less than one one-thousandth of an inch thick and that has a width variation along its length equal to plus or minus one one-thousandth of an inch. Congruency of the heads and tracks is obtained by controlling the forward speed of the tape.

These critical dimensions show that most existing limitations of recording are, instead, limitations of mechanical precision. In spite of these difficulties, however, manufacturers have built systems that can record at digital rates as high as 1 gigabit per second. Of course, at the moment, such systems are quite expensive.

**Breakthroughs Needed**

The necessity for mechanical precision and the complexity of recording systems could be circumvented by an all-electronic...
recording method that gets away from scanning and that uses three, instead of two, recording dimensions. In a way, tape recording uses a volume instead of a surface because the tape surface is wound on itself to create closely packed layers. But the surface is narrow and extremely long, and it takes a long time to scan from one end to the other. Historically, tape has been used only for applications where access times are not critical.

Use of the depth dimension of a recording medium could be very powerful. Imagine a two-dimensional matrix as shown in figure 1, where each junction is a switch that is closed for a 1 and open for a 0. If each junction has a volume of a 1/1000-inch cube (25 micrometers), then a 1-inch square (2.5 centimeters) would contain 1 million junctions and 1 million bits. If, however, you add layers of equal thickness (in the depth dimension) to form a cube, the capacity increases a thousandfold to produce a potential capacity of 1 billion junctions.

The old magnetic core storage used in early computers was organized in this cubic fashion. The problem was, a core measured an appreciable fraction of an inch. Not only was the core assembly large, but it was invariably accompanied by at least two even larger racks of switching circuits used to drive the cores.

A cubic volume having 1/1000-inch dimensions is about 300 times greater than the volume of magnetic material devoted to recording a bit on magnetic tape. There ought to be some kind of simple switch that fits within such a comparatively large volume, yet this technology has eluded researchers for decades. ICs come closest to the ideal. IC technology may ultimately provide the capacity and cost-effectiveness needed to replace disk storage and even some tape storage.

High-Speed Serial Memories
The Apollo astronauts left an array of optical reflectors on the surface of the moon. Any beam of light that strikes this array will return along the same path to the source of illumination. Imagine a laser beam, digitally modulated at a rate of 2 gigabits per second, projected from the earth to this array of reflectors. The beam's round-trip transit time is 2.58 seconds, so 5.16 gigabits are contained within the beam before the first bit is returned to earth. In other words, 5.16 billion bits are spread out as ½-foot-long bundles of photons between the earth and the moon.

After completing a round trip, the pulses are detected, regenerated, and used to modulate the laser beam again. The stored information circulates in a never-ending stream of light pulses. Information is erased, added, and extracted simply by momentarily interrupting the beam in the right places and then making the desired changes. Now you have a 5.16-gigabit memory system with an average access time of 1.29 seconds, and it is totally nonmechanical. This concept is illustrated in figure 2.

If you use 100 different light wavelengths simultaneously, continued
you increase the system’s capacity to half a terabit. The data transfer rate is increased to 200 gigabits per second, but the access time remains 1.29 seconds. Not bad. And you must admit that the recording medium is inexpensive.

Obviously, this system is impractical for several reasons, but it could be a practical means of storing volatile information aboard a synchronous satellite that has a continuous view of the moon. Nevertheless, the concept shows that a serial memory is useful if the string is long enough and the propagation fast enough.

A fiber-optic cable as long as the distance to the moon would be too expensive as a transmission medium because half a foot of fiber-optic material per bit is not economical. Besides, light attenuation over such distances is excessive, and light pulses would not remain coherent over that distance in any medium other than space. We need a form of energy that propagates much slower than light and much faster than sound and that remains coherent over long distances.

**Recording Technology vs. Nature’s Memory**

The human brain weighs about 3 pounds and has a volume of approximately 85 cubic inches. Researchers estimate that the brain contains between 10 billion and 100 billion neurons. If you use the larger number and apply it to a unit cube (see figure 3), then along any axis of the cube the neuron density is 10^62 neurons per inch.

A magnetic tape has about 1000 tracks per inch of width. It can store 60,000 bits per linear inch, so it has an area density of 60 million bits per square inch. Tape is wound on itself within a reel, and since many tapes are only one two-thousandth of an inch thick, a density of 2000 layers per radial inch can be achieved.

The storage density of current magnetic tape is about two orders of magnitude greater than the estimated neuron density of human brain tissue. Of course, human brain tissue performs many more functions than memory. Also, the brain probably receives much more memory than 1 bit per neuron.

Scientists estimate that the human brain has a digital storage capacity equivalent to 10^14 bits, a number that represents a storage density an order of magnitude greater than magnetic tape. Regardless of the comparative merits of living and nonliving memory systems, the use of three dimensions is a great aid in achieving high volumetric storage density.

Magnetic tape provides three-dimensional storage, since it winds onto itself as the spool turns. But you can access data only by unwinding the reel until you reach the place where your specific information is stored, a process that can require minutes. A disk, on the other hand, provides rapid access to data, because the whole surface moves by the head with each rotation. But there is only one disk to a drive—there is no third dimension (depth)—so disks have limited capacity.

**A New Era**

Big, fast, number-crunching computers that provide fast access to vast quantities of information are not well suited to certain applications. Robot control and machine vision, for instance, could be handled more efficiently using a different kind of computer architecture. Carefully programmed digital computers...
can adequately control simple robot arms and highly specialized machines, but general-purpose robotic devices need to “see” what they are working with so that they can adapt to a constantly changing environment. Ideally, computers should make sense of TV images in real time, respond to human voice instructions, and communicate using language.

One architecture that offers such potential is constructed of neural networks, which, like the brain, don’t give numerical answers accurate to the tenth place, but rather deal in approximations, guesses, probabilities, and generalizations. Why use such an architecture? There are several reasons.

First, the logic must be adaptive rather than programmed. Whereas digital computers require precisely organized programs that control and sequence every internal operation, neural network machines will modify their internal logic based on external stimuli and experience. In other words, they will learn. Second, the computer must be capable of providing its own input from scanned images, sounds, and tactile sensors. Third, the controlled machine must respond in real time to external stimuli. Finally, the machine’s internal logic must adapt to changes in external conditions and to differences in the missions it is assigned.

Language is a good example for illustrating the uses of neural networks. It is, after all, a relatively simple audible code that describes objects (nouns), actions (verbs), and modifiers (adjectives and adverbs). Primitive languages start as utterances of sequences of sounds wherein the combination and order of the sounds are used to denote things and actions. Later, as a civilization develops, its people visually code the words by substituting written symbols for the sounds. The dictionary is really a codebook.

Most images contain complex combinations of lines, curves, angles, spots, highlights, shadows, and other characteristics too numerous to list. The challenge in developing machine vision is to learn what features of images are important for comprehension and then to develop neural networks that process images in real time. Digital techniques are simply too complex and too slow. One reason for making neural networks internally adaptive is so that they can be taught to recognize images rather than being hard-wired or rigorously externally programmed.

Sound interpretation is just as complex a task. People who develop speech privacy systems are constantly amazed at the brain’s ability to make sense of distorted, inverted, or frequency-modified speech.

Imagine a two-dimensional matrix folded so that the inputs and outputs are on the same side of the sheet (see figure 4). Roll the folded matrix until it is a three-dimensional object. Such cornucopian structures are present in the brain in large numbers. It seems probable that a large part of the brain is a giant folded sheet in which three-dimensional logic operations that take place through the thickness of the sheet may be confined to only a few hundred. The brain derives its speed not by running with a fast clock, but by using a logic that deals with visualizations, sounds, sensations, tastes, and smells that are coded at a much higher level than the bits that rush around in a digital computer.
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Memory and Logic
If you set out to build electronic machines that deal with sounds and images, and if you design these machines to use that information to perform work in real time, the circuits you use would probably not distinguish between memory and logic. Indeed, memory and logic would be one and the same. Instead of being hard-wired, the memory/logic would adapt to stimuli by producing the required responses and then locking in those responses, preventing further change. In other words, the machines would be programmed by experience.

Human beings shopping for a new computer of this kind would use different criteria than they use when buying a digital computer. They would measure its efficiency by its intelligence quotient and the amount of training it had had, as opposed to its word-length mastery, memory size, and clock speed. In the future, you may encounter a "computer resume"—a statement of the machine’s inherent capability (its intelligence) and a listing of the kinds of training it has received.

New architectures will require new technology regarding switching phenomena, switching devices, structures, interconnects, and packaging. While solid-state electronics and magnetic and optical recording may play a part in such architectures, other technologies, such as electrochemistry, may play the dominant role.

Hazarding a Prognostication
Predicting technological progress can be hazardous to one’s reputation, what with unforeseen breakthroughs always possible. Nevertheless, I predict that unless computer scientists learn how to record information on molecules, the trend toward smaller and smaller bits will come to an end in the foreseeable future. Emphasis will switch from media improvements to system improvements in order to meet the burgeoning demands of the information age.

Data rates will increase, and access times will decrease, through the use of simultaneously active transducers arranged in clever and economical arrays. Capacity can be increased by using larger surface areas that are scanned by the arrays in novel ways. New recording systems will hold larger numbers of media packages that can be loaded quickly without human intervention. The tape format, because of its high volumetric storage density, will probably never go away.

Once these successes have been achieved, look for the emergence of a new kind of computer—one that may sit at a nearby power source and have lunch with you.

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You can use Turbo Pascal 5.5 to learn
the principles of OOP

Dick Pountain

Last year, interest in object-oriented programming exploded, and now major language vendors race to add object-oriented extensions to their products. You already have a choice of object-oriented C and Pascal compilers, and soon even BASIC is to get the OOP treatment. Yet only two years ago, OOP was still an avant-garde technique, largely confined to a subculture of Smalltalk users. Its utility was seriously questioned by professional programmers. Why this intense new interest, and is it justified?

The Invasion
The interest in OOP is partly due to manufacturers hyping it as a value-added ingredient to expand sales. But such hype is usually based on a substratum of fact. The fact in this case can be summed up in a single word: graphics. The widespread introduction of graphical user interfaces during the 1980s has increased the size and complexity of programs to a point where conventional structured-programming techniques can't manage them effectively. A stronger methodology is needed, and OOP provides just that. There is another connection; much of the pioneering work on both OOP systems and GUls was performed at Xerox’s Palo Alto Research Center. For a decade, PARC “graduates” have been dispersing throughout the industry, to Apple, IBM, Microsoft, Hewlett-Packard, Adobe, and others, taking the OOP message with them.

This historical conjunction of OOP systems and GUls has led to the widespread misunderstanding that “object-oriented” has something to do with graphical objects on a screen. Some manufacturers perpetuate this confusion by describing quite conventional applications as “object-oriented” because they display a couple of icons. The unfortunate choice of this same term to differentiate vector-based from bit-mapped drawing programs has only stoked the confusion.

OOP is a general-purpose programming methodology (just like structured programming) that can just as well be applied to a disk operating system or a payroll program as to a graphics program. Its purpose, like that of structured programming before it, is to help programmers write more stable, intelligible, and maintainable programs in less time. An application developed using an OOP system need look no different from one written in an ordinary language. If the programmer chooses to make an application’s underlying object-oriented characteristics available to the user (say through a programmable user interface, or for updating purposes), only then does it deserve to be advertised as object-oriented.

In addition to this terminological confusion, there seems to be apprehension on the part of many programmers that OOP systems are difficult, obscure, or inefficient. I hope to show that this need not be the case. OOP can be viewed as the next logical step beyond structured programming, and objects are best understood as an extension of the familiar idea of records and structures. I’ll use Borland’s Turbo Pascal 5.5 to illustrate the points, because it provides an easy transition from the old style to the new.

Objects and the Real World
Most computer programs exist in order to replace or to assist manual operations on real-world objects. In some sense, they contain models of the real world. In a payroll program, numbers might represent checks or wads of bank notes. In a word processor, strings of ASCII codes represent words that will eventually be printed on paper. Even an operating system is in some sense modeling the real physical resources of the computer itself, the memory and disk space.

Modern programming languages provide an expressive way to model real-world objects in the form of user-defined data types built with aggregates of simple data types representing attributes of the object. For example, in Pascal you might represent spherical objects using variables of a record type:

```
TYPE Sphere = RECORD
    { Position in coordinate space }
```

continued
The record encapsulates all the data relevant to a particular spherical object. When you are dealing with the whole object, you can refer to Balloon1, but if you wish to see its internal details, you can refer to, say, Balloon1.radius. The implementation of user-defined data types is a big step forward from using an unconnected bunch of variables. To some extent, it mimics the cohesion of the real object itself.

The impression of cohesion can be carried through into the actions and behavior of the object if you write procedures to manipulate the record fields in such a way that they clearly "belong" to the type:

```
PROCEDURE Infl anute(ball: Sphere; ratio: REAL);
BEGIN
  ball.radius := ball.radius * ratio;
END;
```

Here, parameter type-checking ensures that operation Inflate can only be used on type Sphere. To perform the operation, you could say Inflate(Balloon1, 1.5). Notice that you do not need to mention the name of the field radius explicitly, except in the definition of Inflate itself. By writing a procedure for each operation to a record type, you need never refer to actual field names in the main part of your program. If you decide to change the definition of a Sphere (e.g., by adding or subtracting fields), only a few operation procedures would need to be changed. The main program would be insulated from the alteration. When you are developing large programs, this concept can save plenty of programming time and forestall many errors. Unfortunately, ordinary Pascal and C can't enforce this programming style. There is nothing to stop you from writing procedures like this:

```
PROCEDURE MessyStuff(....
BEGIN
  .......
  Profit := Revenue - Cost;
  Wallpaper := green;
  Balloon2.radius := Balloon1.radius * 2.3;
  .......
END;
```

Object-oriented languages encourage clean encapsulation of the operations (usually called methods) associated with a data type by making them part of the definition of the type itself. User-defined types become active entities containing both data and operations on the data. This is nicely illustrated in Turbo Pascal 5.5 because the syntax remains almost the same as above, with the word OBJECT replacing RECORD:

```
TYPE Sphere = OBJECT
  x,y,z: INTEGER;
  radius: REAL;
  PROCEDURE Inflate(ratio: REAL);
END;
```

The type Sphere tells us not only what a sphere looks like (its position and size) but also what it can do (it can inflate itself). The variables Balloon1 and Balloon2 are called objects, and they are instances of the type Sphere; the type is like a mold, and its instances are castings from the mold.

The type definition of the object, its body is defined anywhere later in the program, just like the implementation section of a unit. This means that the body has to be called Sphere.Inflate to distinguish it from the body of any other Inflate belonging to another type.

This unfortunate syntactic requirement is a potential source of confusion. Just remember that the method's real name, in the type definition and when it is invoked, is simply Inflate, and that any number of other types can also have a method called Inflate.

Because it is bad practice to access data fields in an object directly, you should always provide a method for initializing new objects rather than using direct assignment to their fields:

```
Balloon1.Init(0,0,0,10.25);
```

instead of

```
Balloon1.x := 0; Balloon1.y := 0; ....
```

In a strictly object-oriented language like Smalltalk-80, you aren't allowed to directly access the data fields in an object at all, so you can only manipulate them via methods like Init and Inflate. To find out how big a sphere is, you would have to add a method that returns the value of radius. Turbo Pascal 5.5 and C++ are both less strict than this and let you access fields directly, just like an ordinary record (e.g., Balloon1.radius).

This means that you can still write procedures like MessyStuff if you really want to. C++ at least offers the "private" keyword to bar such access, but it's still up to you to decide whether you use it or not.

Users of Modula-2 (and versions of Turbo Pascal lower than 5.5) may be muttering that they can achieve a similar encapsulation of procedures with their data structures by using modules or units. This is perfectly true. The module mechanism is a valuable tool that effectively localizes program changes. OOP goes further, though. If, in addition to spheres, you create some new types, say cylinders and toruses, an object-oriented system will let you use the same method name (e.g., Inflate) for all three types, whereas in a module or unit this would cause name clashes, forcing you to choose unique names or qualify them (e.g., TorusInflate or Torus.Inflate). The significance of this goes beyond mere convenience. Given run-time binding (of which more below), an object-oriented program can apply the method Inflate to objects whose type is not known in ad-
vance, leaving it to the object to work out how best to Inflate itself.

It is this feature of OOP, called polymorphism (from the Greek for "many shapes"), that constitutes the real programming revolution. Programming is turned inside out; ask not what you are going to do to an object, but ask what the object can do for you. More and more of the intelligence is moved out of the application program and into reusable "smart" objects.

Given sufficiently large object libraries, programming can be reduced to little more than clicking objects together like plastic bricks. But to gain the full benefits of polymorphism, some way is needed to manage the potentially huge proliferation of object types. The answer lies in inheritance— the ability of object types to inherit properties from a parent type.

Inheritance

One of the most powerful tools for managing complexity is the hierarchical structure (tree structure). I'm writing this article on a computer with 1287 files on its hard disk. I never need to see that many files, because DOS's tree-structured directories let me deal with just the few files of current interest.

The biological sciences discovered the power of hierarchical description centuries ago. The Linnaean classification of living things must rank as one of science's greatest achievements. For example, the common frog can be named by following one path through the tree:

Kingdom: Animalia
Subkingdom: Metazoa
Phylum: Chordata
Subphylum: Craniata
Class: Amphibia
Order: Anura
Family: Ranidae
Genus: Rana
Species: temporaria

Just nine statements identify one kind of creature from tens of millions. Using a DOS-like syntax, you might locate an instance of a frog called Kermit as follows:

c: \ Animalia \ Metazoa \ Chordata \ Craniata \ Amphibia \ Anura \ Ranidae \ Rana \ temporaria \ Kermit.

OOP uses a similar principle, except that instead of classifying discovered objects, you are creating new classes of objects to fit the application. Encapsulation of objects and methods is a boon to good program structure and effectively localizes program changes, but if your program requires hundreds of different object types, it can still become unmanageable. An inheritance hierarchy can be used to dramatically reduce the number of types that need to be defined by factoring out their common features, just as the Linnaean classification can home in on the common frog with only nine labels.

For example, spheres, toruses, and cylinders share the property of having a position in space. To factor this out, you might define a parent type called Location as follows:

```pascal
TYPE Location = OBJECT
  x, y, z: INTEGER;
END;
```

and then define spheres, toruses, and cylinders as child types that inherit this position property:

```pascal
TYPE Sphere = OBJECT(Location)
  radius: REAL;
END;
Torus = OBJECT(Location)
  major_radius, minor_radius: REAL;
END;
Cylinder = OBJECT(Location)
  length, radius: REAL;
END;
```

In the Turbo Pascal 5.5 syntax, the statement "OBJECT(Location)" denotes inheritance from the parent type Location; all three child types automatically possess data fields called x, y, and z, even though they are not declared explicitly. Methods can be inherited in just the same way. For example, Location might have three methods that move the object along one of the axes, and these could happily be inherited by Sphere, Torus, and Cylinder, all of which are potentially movable:

```pascal
TYPE Location = OBJECT
  x, y, z: INTEGER;
PROCEDURE x_move( distance: INTEGER);
PROCEDURE y_move( distance: INTEGER);
PROCEDURE z_move( distance: INTEGER);
END;
```

On the other hand, the method Inflate cannot so easily be factored out, because inflating a torus is rather different from inflating a sphere. Each child will need its own version of Inflate. Location happens to be a useful type in its own right. You might want to create instances of Location, but they are not required.

Abstract types exist for the sole purpose of providing inheritance. From the biology example above, there is no such animal as a Craniata; similarly, there are no instances of abstract types.

Designing good inheritance hierarchies is the essence of good OOP. If you choose sufficiently flexible and generic types for the root of the tree, you can reuse a large percentage of your
code. Writing new programs reduces to merely creating a few child types. Smalltalk-80 exemplifies this idea with its huge database of existing classes or types. For example, in Smalltalk a String is a subclass (i.e., child) of ArrayedCollection, which is a subclass of SequenceableCollection, which is a subclass of Collection, which is the abstract type for a group of anything. At this point in studying programming, you put down Knuth and reach for Kant.

C++ and some object-oriented variants of Lisp support multiple inheritance, where a type may inherit data and methods from more than one parent. This sounds like a very powerful idea, but it should be used with great care and restraint. The whole point of a hierarchy is that it tames complexity by restricting the paths you can follow from the root. Adding cross-linking paths from branch to branch produces a network. Networks do not have this complexity-taming property, but instead get you lost or cause you to go round in circles. A torus should have feathers.

You might use multiple inheritance safely when one of the parents is a highly generic data-structuring class, such as a stack, linked list, or queue. Inheriting from this class would confer the properties of stackability and listability on the child type.

Binding Time
New object types sometimes find that they have inherited methods that require modification to be useful. A child type can always "override" an inherited method by redefining it. Often, all that is required is the addition of an extra action to the method. In this case, the child can call the original inherited version (by qualifying it with the parent's name) and then add its own new code. For example, suppose that Sphere might want to alter the x_move method it inherited from Location in order to keep a tally of total distances moved. The overriding definition might look something like this:

```plaintext
PROCEDURE Sphere.x_move(distance: INTEGER);
BEGIN
  Location.x_move(distance);
  tally := tally + distance
END;
```

Calling the parent method is not done in this way just to save effort; it is an important part of the OOP style. It ensures that any alterations made to methods near the top of an inheritance family propagate down to all the descendants. In other words, any changes you make to Location.x_move will automatically be passed on to Sphere.x_move and to any child types that inherit it.

The ability of descendant types to override inherited methods introduces a potential ambiguity. Say you give Location a new method called knight_move, which calls x_move as one of its actions:

```plaintext
PROCEDURE Location.knight_move;
BEGIN
  x_move(5);
END;
```

It ensures that alterations made to methods near the top of an inheritance family propagate down to all the descendants.

The ability of descendant types to override inherited methods introduces a potential ambiguity. Say you give Location a new method called knight_move, which calls x_move as one of its actions:

**continued**
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This new method will be inherited by all Location’s descendants. The question is, when Sphere executes its inherited knight_move, which x_move will be called? Will it be Location’s x_move or Sphere’s own overriding version? In other words, when do method names get “bound” to the code they execute—at compile time or at run time? If they get bound at compile time, the address of Location’s x_move or Sphere’s own overriding version? In other words, when do method names get “bound” to the code they execute—at compile time or at run time? If they get bound at compile time, the address of Location’s x_move is permanently compiled into knight_move, and this version is always used, even when it is a descendant invoking knight_move. However, if method names get bound at run time, then knight_move can look around, see who is calling it, and check whether each has its own version of x_move to call.

Late binding (also called run-time binding) opens up the potential of polymorphism and truly generic programming. When binding is left until run time, your program doesn’t need to know the type of the objects it is working on. Your program can invoke a method, and each of the receiving objects will execute its own version of the method to achieve appropriately customized actions. On the other hand, early binding (compile-time binding) causes the same parent method to be invoked on all objects, and this removes the possibility of any customization.

As is so often the case, a trade-off is involved. Early binding produces no execution time overhead, the method being executed exactly like a normal compiled procedure call. This means that you get all the benefits of encapsulation and some of the benefits of inheritance (but not polymorphism) for free. Late binding involves setting up a run-time table search to match method names to local method code, thereby imposing some performance overhead.

Smalltalk-80, being semi-interpreted and strictly object-oriented, uses only late binding. C++ and Turbo Pascal 5.5, being fully compiled and hybrid languages, offer you the choice of early or late binding. With them, you can develop programs using late binding and then optimize performance using early binding on just those methods that do not need polymorphic behavior. However, the rewards of late binding are so great that it should never be relinquished lightly.

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An Example
To demonstrate late binding in Turbo Pascal 5.5, I've modified my previous example somewhat (see listing 1). I've added a new type called Solid, which inherits from Location and adds a function that computes volume. Solid's own version of Volume is a dummy function that exists only to be inherited, since Solid is an abstract type with no instances. Solid also contains a function, Cost, which uses the volume in a rather arbitrary formula to calculate the cost of an object. The point of the demonstration is that Sphere, Torus, and Cylinder (and any other shape) can inherit the Cost function unchanged merely by supplying their own method for computing volume. In a real application, Cost might be a hugely complex method that you have no wish to repeat in every child type. By using late binding, you don't need to.

Turbo Pascal 5.5 borrowed the keyword VIRTUAL from C++ to indicate those methods that are to be bound late. (Note that all the overriding versions of Volume must be declared virtual, too.) When late binding is used, the Init method has to be a special kind of method, a CONSTRUCTOR, which builds the run-time method tables as well as initializing the object, and it must be invoked before any other methods can be called. To see the effect of early binding, try removing the keyword VIRTUAL wherever it appears and then run the code. The cost for Balloon, Tire, and Sausage will always result in 2500, because the dummy version, Solid.Volume, is used in each case and returns nothing. When you replace the VIRTUALs, the costs are calculated using each object's own volume function. You get different results from each.

You can add any new type of solid, such as Ellipsoid, and it will automatically inherit the Cost function as long as you provide it with a method to calculate its own volume. You can do this without ever seeing the source code for Solid; indeed, Solid might exist only as part of a compiled library.

Coping with Complexity
As we enter the age of WIMP interfaces, multivendor network transparency, remote procedure calls, multilayer communications protocols, and the rest, programs can only get bigger and hairier. OOP seems like the best chance we have of coping.

Is there a downside to OOP? Larger source files, the run-time overhead of late binding, and the difficulty of learning large class or type libraries have been cited. Frankly, with languages like Turbo Pascal 5.5 and C++, the first two are not serious problems. Learning library routines cuts both ways. When you build more and more reusable types (which you can extend thanks to late binding), your programming tasks become lighter as your libraries grow heavier. Some implacable law of conservation of information seems to say that you can't kill complexity but only shovel it from one place to another. The crucial point is that the code in the library that you are learning is tried, tested, and debugged. You may never need to reinvent a wheel, but you do need to be able to find the right one in the storeroom.

Dick Pountain is a BYTE consulting editor, technical author, and software consultant living in London, England. You can contact him on BIX as 'dickp.'
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The small computer system interface is a parallel, multimaster I/O bus that provides a standard interface between computers and peripheral devices. Despite its misleading name (which incorrectly implies that it’s useful only for small computers) and unflattering appellation (most people pronounce it “scuzzy”), SCSI is fast becoming the method of choice for connecting disks, tape drives, CD-ROMs, WORM (write once, read many times) drives, communications devices, and even bar code readers to computers of all sizes.

A SCSI disk drive that can provide screamingly fast I/O to a Sun SPARCStation or a NeXT cube will work just as well (although more slowly, of course) on an 8-bit Atari 300XL.

In this two-part article, I’ll first cover the history of SCSI. I’ll then move on to describe the technical details of this versatile interface.

A Brief History of SCSI

SCSI has been an official ANSI standard (ANSI X3.131-1986) since 1986, but its roots go back to the I/O buses used on IBM mainframes as early as the 1960s. The IBM 360s (with the exception of the 360/20) had a byte-wide, parallel I/O bus that could do fast block transfers to and from peripherals. In the earliest models, this bus was called the selector channel, and it could talk to only one logical device at a time. This bus later became the block multiplexer channel and gained the capability to keep several conversations with different peripherals going at one time.

This IBM bus, also known as the OEM channel, was the most common way for third parties to interface peripherals to IBM equipment. It became so popular, in fact, that the U.S. government made it Federal Information Processing Standard 60. Other computer manufacturers promptly sued the government, claiming that this gave IBM an unfair competitive advantage. They didn’t win the suit, but they were able to exert sufficient political pressure to keep ANSI from adopting the bus as a standard with no changes.

ANSI, however, did want to create a standard for a nonproprietary parallel I/O bus. Therefore, in the early 1980s, the ANSI X3T9.3 committee began work on a bus called the intelligent peripheral interface (IPI), which provided a super-set of the OEM channel’s capabilities.

Like the OEM channel, IPI made the host CPU the sole bus master and had similar states and state transitions. But unlike the OEM channel, it could transmit 16 bits at a time instead of just 8. (As a concession to the de facto standard, IPI had a mode in which it could split those 16 data lines into two unidirectional 8-bit buses and work similarly to the OEM channel.)

At about the same time, engineers at Shugart Associates (a disk drive maker) were taking a different tack. They also saw the need for a flexible parallel I/O bus that wasn’t tied to standards from the 1960s, but they designed their own interface, called the Shugart Associates system interface. Unlike the OEM channel or IPI, SASI was intended to be a low-cost peer-to-peer interface. The initial specification was straightforward and a little more than 20 pages long. Three manufacturers—DTC, Xebec, and Western Digital—embraced SASI as a practical standard and built controllers for it. Within only a few years, there were many units in the field.

When proponents of SASI approached ANSI with the suggestion of making it a continued
standard, they found IPI competing with another high-level interface, called the intelligent system interface (ISI), for the attention of the X3T9.3 committee. Rather than becoming a third contender in this battle, the SASI proponents opted instead to work with the X3T9.2 committee, which dealt with low-level interfaces, and called the new standard SCSI to set it apart from the others.

In retrospect, this was more a political ploy than a true distinction. SCSI and its soon-to-be-finalized successor SCSI-2 have most of the capabilities of IPI and a few that IPI lacks. But the maneuver worked. The X3T9.2 committee completed the specification in 1984, and it was published in its approved form in 1986. Even before the specification was finalized, SCSI began to see much more widespread acceptance than IPI, whose use is still largely limited to the mainframe world. Figure 1 shows the chronology of SCSI’s evolution.

SCSI Principles
As mentioned earlier, SCSI was designed to be an improvement over the OEM channel. Two improvements were of special importance. First, the OEM channel consisted of two unidirectional 8-bit data paths, rather than a single bidirectional one. Why the duplication? It turned out that the two paths were necessary to minimize the channel turnaround time, the time it took to change the direction in which information was sent. Most bus drivers can change the direction in which they carry data within hundreds of nanoseconds, but this wasn’t fast enough for the OEM channel.

Why was timing so critical? Because the commands used to control disk drives via the OEM channel were low-level. The CPU might issue a Find Sector ID command, and then—when the disk drive signaled that the sector had been found—it needed to issue a Read Sector or Write Sector command before the disk head could traverse the short gap between header and sector. There was no time to turn the bus around during this gap. SCSI’s designers eliminated the need for such fast turnaround by implementing complete logical commands—commands that contained both the address of a sector and instructions about what to do with that sector.

SCSI improved on the OEM channel in a second way. Systems using the OEM channel could talk to one another and/or share peripherals only if they were connected via an expensive ($60,000 or more) multichannel switching unit. By contrast, SCSI implements true peer-to-peer communications; it can accommodate connectivity among multiple CPUs and multiple peripherals.

Like the OEM channel, SCSI makes it possible for several commands to peripherals to be in progress at the same time. The host that initiates a command can disconnect after issuing the command, freeing the bus until the peripheral is ready to respond. In the meantime, the same host can talk to other peripherals, or other hosts can use the bus. Thus, a SCSI system can perform complex concurrent I/O operations with ease. When a peripheral is finished with the command, it can reconnect to the host to transfer data or status information.

SCSI was an early peripheral interface to use logical, rather than physical, addressing. A typical modified-frequency-modulation (MFM), run-length-limited (RLL), or ESDI disk drive controller requires the host to know where bad blocks are on the drive and avoid them. MS-
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DOS, for instance, encodes this information in the file allocation table.

SCSI disk drive controllers, however, can take care of this bookkeeping chore themselves, making storage appear to the system as one continuous sequence of good blocks. Since the controller (especially an embedded controller) is likely to be able to take advantage of special knowledge of the drive’s characteristics when handling defects, it is likely to do the job better. And because the system doesn’t need to devote cycles to the problem, this concurrent-processing feature will generally make things run faster.

Command queueing is another important SCSI feature. If one or more hosts make many requests of a peripheral device, that peripheral (if it implements queueing) can queue up commands for later execution. This can let a controller optimize I/O by implementing strategies like elevator seeks.

Targets and Initiators
The SCSI bus can support up to eight devices (i.e., host adapters or peripheral controllers). At first blush, this seems rather limiting, but it really isn’t; each device can in turn have eight logical units, and each logical unit can have 256 logical subunits. Thus, there can be—at least in theory—a total of 14,000 peripherals on the bus if there’s one host and each peripheral is a logical subunit.

Each SCSI device can be an initiator (i.e., a device that issues commands), a target (i.e., a device that performs commands), or both. A SCSI bus must always have at least one initiator and one target to be useful, but it can have multiple initiators and/or targets (see figure 2).

Two Flavors
The SCSI bus comes in two flavors: single-ended SCSI, in which each signal’s logic level is determined by the voltage of a single wire relative to a common ground, and differential SCSI, in which the level is determined by the potential difference between two wires. Differential transmission is more robust and less subject to electrical noise.

The SCSI specification states that a single-ended bus can be no more than 6 meters long and should be used to connect devices within a cabinet only. A differential bus can be up to 25 meters long and can be used to connect devices in different cabinets. (Some manufacturers, like Apple, use single-ended SCSI to connect devices in different cabinets. While this isn’t, strictly speaking, a violation of the specification, it isn’t what its design...
ers intended.) Differential and single-ended devices shouldn't be mixed on the same bus. The text box “The SCSI Signals” on page 272 describes what each signal does and shows the SCSI pin-outs.

**Just a Passing Phase**

When the SCSI bus operates, it makes orderly transitions between bus states known as *phases*. The phase determines the direction and content of the data lines. The eight possible phases are BUS FREE, ARBITRATION, SELECTION, RESELECTION, COMMAND, DATA, STATUS, and MESSAGE. The last four of these are called *information transfer phases*.

The phase diagram in figure 3 shows the relationships between the phases and the possible phase transitions. The system always comes up in the BUS FREE phase or reenters this phase after the bus is reset. In the BUS FREE phase, the BSY signal isn't asserted (it is in all the other phases).

In the ARBITRATION phase, all would-be bus masters compete for control of the bus. This phase begins when an initiator, or a target that wants to get back in touch with an initiator after being disconnected, attempts to gain control of the SCSI bus. Each potential master asserts the BSY signal (which is a wired OR, so there's no electrical conflict) and sets the data bit (0 through 7) corresponding to its SCSI ID. The device with the highest ID wins, and the others then back off.

In the SELECTION phase, an initiator selects a target for a command by placing the target's ID on the data lines and asserting the SEL signal. (If the system is nonarbitrating, the initiator doesn't need to compete for the bus and can skip to this phase from the BUS FREE phase.) At the end of this phase, the target (if it exists) takes over control of the bus timing and phase transitions for the remainder of the transaction.

The RESELECTION phase occurs when a target wins the arbitration and re-establishes contact with an initiator that previously sent it a command. The target places the initiator's ID on the data lines

---

**Figure 2:** A SCSI I/O bus must have at least one initiator and one target (a) to be useful. It can also have multiple targets (b) and multiple initiators (c). SCSI provides commands that let initiators share peripherals safely.

---

**Figure 3:** The SCSI bus always comes up in the BUS FREE phase. A system can be nonarbitrating (a) or arbitrating (b); if arbitration isn't implemented, there's no ARBITRATION or RESELECTION phase. Nonarbitrating systems usually consist of a single host and a single peripheral controller; ARBITRATION and RESELECTION aren't necessary because the host is always in control, and there's no need for a disconnect/reconnect operation.
CSI is simple compared to most computer and peripheral buses; it has only nine data lines and nine control signals. Table A shows the pin assignments for single-ended SCSI; Table B shows the assignments for differential SCSI.

The signals are as follows:

**ACK (acknowledge)** The initiator asserts this line to acknowledge that it has accepted or supplied data in response to the REQ signal (which is asserted by the target). All asynchronous data transfers over the SCSI bus use the REQ/ACK handshake sequence.

**ATN (attention)** A host asserts this signal to let a controller know that it has a message for it. The controller can then ask for the message using the MESSAGE OUT bus phase.

**BSY (busy)** This signal is asserted by one or both of the parties to a transaction to indicate that the bus is in use.

**C/D (control/data)** This signal is controlled by the target during a transaction, and it indicates whether control information or data is on the bus.

**Data lines** -DB(0), -DB(7), and DB(P) These lines form a bidirectional data bus with optional parity. In addition, they carry the SCSI IDs of devices when they contend for the bus and when they establish (or reestablish) connections with other devices. (Each ID corresponds to one line on the bus being active.)

**DIFFSENS (differential sense)** This line, which is found only on differential SCSI buses, enables the differential drivers.

**I/O (input/output)** This signal indicates the direction of a data transfer relative to the initiator (host). It’s driven by the target and also distinguishes between the SELECTION (done by the initiator) and RESELECTION (done by the target) bus phases.

**MSG (message)** This signal, which is controlled by the target, indicates when a message is on the bus.

**REQ (request)** The target asserts this signal to begin an asynchronous bus transfer using the REQ/ACK handshake sequence.

**RST (reset)** This signal resets the bus. Any device can assert it; it is normally used only at power-up time or when a selected device isn’t responding.

**SEL (select)** A host uses this signal to specify the controller that it wishes to talk to or vice versa. (The ID of the device being selected appears on the data lines.)

**TERMPWR (terminator power)** This line provides power to the termination resistor networks at either end of the bus.

---

### Table A: In single-ended SCSI, the odd-numbered pins are all grounded (except for pin 25) to provide shielding between the lines. Pin 25 is left open, so that if a single-ended device is accidentally plugged into a differential SCSI bus, it does not short the TERMPWR line to ground and potentially blow out a power supply. A minus sign before a signal name means it’s active low.

<table>
<thead>
<tr>
<th>SINGLE-ENDED SCSI PIN ASSIGNMENTS</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin number</td>
<td>Signal</td>
</tr>
<tr>
<td>2</td>
<td>-DB(0)</td>
</tr>
<tr>
<td>4</td>
<td>-DB(1)</td>
</tr>
<tr>
<td>6</td>
<td>-DB(2)</td>
</tr>
<tr>
<td>8</td>
<td>-DB(3)</td>
</tr>
<tr>
<td>10</td>
<td>-DB(4)</td>
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<tr>
<td>12</td>
<td>-DB(5)</td>
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<td>14</td>
<td>-DB(6)</td>
</tr>
<tr>
<td>16</td>
<td>-DB(7)</td>
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<tr>
<td>18</td>
<td>-DB(P)</td>
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<tr>
<td>20</td>
<td>GROUND</td>
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<tr>
<td>22</td>
<td>GROUND</td>
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<tr>
<td>24</td>
<td>GROUND</td>
</tr>
<tr>
<td>26</td>
<td>TERMPWR</td>
</tr>
<tr>
<td>28</td>
<td>GROUND</td>
</tr>
<tr>
<td>30</td>
<td>GROUND</td>
</tr>
<tr>
<td>32</td>
<td>ATN</td>
</tr>
<tr>
<td>34</td>
<td>GROUND</td>
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<tr>
<td>36</td>
<td>-BSY</td>
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<td>38</td>
<td>-ACK</td>
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<td>40</td>
<td>-RST</td>
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<tr>
<td>42</td>
<td>-MSG</td>
</tr>
<tr>
<td>44</td>
<td>-SEL</td>
</tr>
<tr>
<td>46</td>
<td>C/D</td>
</tr>
<tr>
<td>48</td>
<td>-REQ</td>
</tr>
<tr>
<td>50</td>
<td>-I/O</td>
</tr>
</tbody>
</table>

### Table B: In differential SCSI, many of the odd-numbered pins form differential signal pairs with the corresponding even-numbered pins.

<table>
<thead>
<tr>
<th>DIFFERENTIAL SCSI PIN ASSIGNMENTS</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
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<td>48</td>
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<tr>
<td>49</td>
<td>50</td>
</tr>
</tbody>
</table>

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and asserts the I/O signal, as well as SEL, to distinguish this phase from a SELECT phase.

Finally, the system cycles through one or more information transfer phases. The target uses the MSG, C/D, and I/O signals to guide the system through the phases (see Table 1 for the combinations of signals used to denote each phase).

In the COMMAND phase, the target requests a command from the initiator. In the DATA IN or DATA OUT phase— as you might expect—data is transferred.

In the STATUS phase, the target sends a status byte indicating the success or failure of the command, and in the MESSAGE IN or MESSAGE OUT phase, a message passes between the two devices. Typical messages would include "Command Complete," in which the target indicates to the initiator that it's finished performing a command, and "Initiator Detected Error," in which the initiator signals that it has detected a parity error during a data transfer.

A typical SCSI transaction would consist of a COMMAND phase, followed by a series of DATA IN or DATA OUT phases, followed by a STATUS phase and a MESSAGE IN phase (in which the target sends the mandatory "Command Complete" message). However, the initiator can cause the target to enter the MESSAGE OUT phase (and accept a message) by asserting the ATN signal on the bus. It can also reset the bus at any time by asserting RST.

Commands and data can be transferred either asynchronously or synchronously during the information transfer phases. During an asynchronous transfer, the REQ and ACK signals operate in lockstep with the transfer. On a transfer from initiator to target, the target asserts REQ when it's ready for data, and the host asserts ACK when the data is on the bus. The target deasserts REQ when it latches the data, and the initiator, seeing this, deasserts ACK. When data is sent from target to initiator, the REQ line indicates that the target has placed data on the bus, and ACK indicates that the initiator has latched the data.

If the target and initiator agree, however, they can avoid waiting for handshake signals by "windowing" the transfer. The target pulses REQ for each byte of data, and the initiator will eventually pulse ACK the same number of times, but they're allowed to get ahead of one another. This is a synchronous transfer.

In SCSI-1, a synchronous transfer can take place at a predetermined maximum rate of 4 megabytes per second. In SCSI-2, however, the target and initiator negotiate a rate that may be considerably faster than the highest SCSI-1 speed.

More to Come
This concludes my low-level tour of SCSI and the signal lines it uses. In next month's installment, I'll cover the high-level aspects of SCSI. I'll show how the bus phases I've described here fit together into a complete SCSI transaction, give overviews of the common command set and common access method, and describe how SCSI is used in some real-world systems.

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Table 1: The combinations of signals used to denote each phase.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Phase name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSG</td>
<td>DATA OUT</td>
<td>Initiator sends data to target.</td>
</tr>
<tr>
<td>C/D</td>
<td>DATA IN</td>
<td>Initiator sends command to target.</td>
</tr>
<tr>
<td>I/O</td>
<td>COMMAND</td>
<td>Target sends status to initiator.</td>
</tr>
<tr>
<td></td>
<td>STATUS</td>
<td>(Reserved)</td>
</tr>
<tr>
<td></td>
<td>MESSAGE OUT</td>
<td>Initiator sends message to target.</td>
</tr>
<tr>
<td></td>
<td>MESSAGE IN</td>
<td>Target sends message to initiator.</td>
</tr>
</tbody>
</table>

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The parallel port interface (PPI) connects between the printer port on a PC and the printer cable. The PPI holds two Key Tags, one on each side. Each Key Tag contains a secure custom chip which is pre-programmed by Glencoe to only work with the assigned software package. A second Key Tag can be employed to protect another package, or may be used to turn other software packages "on", remotely or on-site.

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You don't need a workstation to have multitasking on your desk.

My mission this month is to inject some enthusiasm into those of you who may have slumped into a depression. I know why it's happening: You've been reading those computer magazines that tell you of the wonders of multitasking and how you need at least a $5000 investment in a 2-megabyte, 25-MHz 80386 machine to share in those wonders. So you look over at your XT clone or your Mac Plus and begin wondering if it isn't time to send that old workhorse to the glue factory. Maybe you could get a second mortgage on the house to pay for an 80386 clone or a Mac II; after all, you've got to have that kind of hardware to do multitasking, right?

Not so fast. To quote Mehitabel the cat: "There's a dance in the old girl yet." There are ways to enjoy the paradise of multitasking on your XT or Mac Plus. You'll have to work a little harder at it than if you had a Sun workstation, but multitasking beyond simply hanging a background print task on a timer interrupt is not out of reach.

What Is Multitasking, Really?

Multitasking is often incorrectly defined as running multiple programs (tasks or procedures) simultaneously. But that can't be; unless you're lucky enough to own a coprocessor board or a cluster of transputers, you've only got one CPU in your machine, and it can only work on one program at a time.

Of course, the trick is that the CPU switches rapidly from task to task so that the system appears to be running several tasks at once. It's like Superboy playing baseball alone, but rushing from position to position so quickly that he becomes the whole team. This task switching is often referred to as context switching. There are two major varieties of context switching: preemptive and cooperative. (As you'll see, there are numerous variations on these themes.)

Preemptive context switching usually occurs at a level so low that the application is largely unaware that it's taking place. A hardware interrupt—usually triggered by the system's real-time clock—causes processing to transfer to a routine associated with the timer interrupt (see figure 1). This routine (usually referred to as the scheduler) saves the system state of the currently executing program, selects another program from a queue of programs waiting their turn, and transfers control to the one selected.

When a program is selected to run, the system (all the CPU's registers and flags) is returned to the state it was in when that program was interrupted, so processing continues right where the program left off—the program has no idea it was interrupted at all. The transparency that this approach provides means that, unless you want your program to communicate with other processes running on the system, you don't have to include any special code to support task switching.

In cooperative task switching, the program takes an active role in providing multitasking. Simply put, the program explicitly says: "Okay, someone else can have the CPU now." There's an understanding of civility here; a program that gives up the CPU presumes that, ultimately, it will be given its turn again.

Just as there are ways to accomplish multitasking at the machine level, there are various ways to bring multitasking to your computer. The spectrum ranges from complete multitasking environments—some that try to maintain DOS compatibility, others that give up the idea of wrestling with DOS and define a...
completely new operating system—to multitasking within the confines of a programming language. I’ll wade into the heavyweights first.

**Love Me, Love My DOS**

DESQview is well known in the pages of this magazine. It has acquired the reputation of an interim solution for those waiting for OS/2. In fact, some suggest that DESQview is powerful enough to suffice in place of OS/2.

DESQview’s claim to fame is its success in running off-the-shelf DOS applications. I have run DESQview for some time now on my 4.77-MHz XT clone, and although I encounter an occasional problem with programs that play illegitimately with the screen, DESQview typically never breaks stride. (I have a Definicon DSI-32 coprocessor board that runs Unix System V. With DESQview, I can open a 64K-byte window to run the communication routine that handles the DSI-32’s disk and keyboard requests and still have plenty of room for XyWrite or Turbo C or whatever. The result: I get Unix running concurrently with DOS on a little XT clone.)

But DESQview is more than just a means of running multiple DOS applications (several multi-DOS products exist, such as PC-MIX from Proware). Quarterdeck provides a complete application programmer interface tool set that allows you to create programs that make use of DESQview’s multitasking capabilities (Quarterdeck refers to such programs as DESQview-specific applications). These capabilities are surprisingly extensive. The DESQview API toolkit consists of a library of assembly routines and macros that allow access to DESQview’s functions through its Int 15H software interrupt hook.

Programs can spawn concurrent processes through the NEWPROC macro. A process is defined by its program information file (PIF), which serves as a kind of program segment prefix and defines parameters such as the amount of memory required by the program, where its window (if any) will initially appear on-screen, whether the program writes directly to video memory, and so forth. You load a PIF into memory and then activate it via NEWPROC as follows:

```
MOV ES, <segment of PIF>
MOV DI, <offset of PIF>
@CALL NEWPROC
```

where @CALL is a macro that sends the NEWPROC command to DESQview. When NEWPROC returns, the top of the stack holds a 32-bit identifier—referred to as a handle—to the new process. This handle is a means of referencing the process in the future. So, for instance, if you wanted to suspend a process, you would execute

```
MOV ES, <high word of handle>
@CALL STOP
```

(Notice that you need only supply the upper 16 bits of the process handle; this is because the lower 16 bits of a process handle are always Os.)

DESQview’s interprocess communications are handled by objects referred to as mailboxes. The DESQview mailbox is continued

---

**Figure 1:** (a) A timer interrupt transfers control to the context-switching routine (CSWITCH). CSWITCH saved the machine state when Task 1 was interrupted. The state is saved onto the rear of the queue. (b) Task 2 moves to the head of the queue, and it restarts where it left off.
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general-purpose; it allows tasks to send messages of arbitrary length to one another (the typical job of a message queue). A task can lock a mailbox, causing subsequent tasks that try to lock the mailbox to be suspended until the lock is removed. So, mailboxes can also do the job of semaphores.

When a new task is created, DESQview automatically builds a new mailbox, which becomes the task's default mailbox. But if one per process is not enough, programs can create additional mailboxes with the NEW command. Once a mailbox is created, your program can associate a symbolic name with it using the SETNAME command. This allows other processes in the system to locate the mailbox by name.

Finally, if you can't see yourself writing piles of assembly calls, you'll be happy to know that an API C Library package is available. It is compatible with most of the popular compilers, and if that's not enough, the source code is included so you can rebuild the library for whatever compiler is your favorite.

**Wendin-DOS**

Wendin-DOS, like DESQview, is noteworthy because it supports many of the features of MS-DOS. However, it seems less tolerant of "ill-behaved" programs (loosely defined as any programs that circumvent DOS and BIOS calls to talk to the hardware). TSR programs also usually go bloopo under Wendin-DOS.

Finally, Wendin-DOS is a separate operating system; when you boot your system, you boot up in Wendin-DOS. (With DESQview, you boot under DOS.)

When you set Wendin-DOS's configuration for boot-up time, you select an interface that is either windowed or switched. The windowed interface allows multiple windows on-screen simultaneously, each running either another program or a shell. The switched interface is for those applications that write directly to the video memory; in this interface, the currently active task has control of the entire screen. The remaining tasks are kept "asleep." To awaken another task, you enter a hot-key sequence, and the current task is put to sleep, its screen is saved, and the new task wakes up and takes over the display.

Happily, Wendin-DOS uses the standard DOS file structure, so you don't have to erase everything to install the new operating system. Wendin-DOS also supports the standard DOS Int 21H interrupts up through DOS 3.3. This translates to less work on your part getting programs running under Wendin-DOS.

Also, Wendin provides an application developer's kit with a library of C routines for calling the operating system's services (the code in the library is compatible with Microsoft C 3.0 or greater).

Processes under Wendin-DOS communicate via global memory blocks and mailboxes. Global memory blocks are similar to Unix V's shared memory capabilities: Your program asks the operating system for a section of memory that, once allocated, can be accessed by other processes if they know the block's name. Your process can create a global memory block using the following system call:

```c
returncode=sys_cregbl(blname, &pages,&address)
```

where `blname` is a pointer to a character string that will become the block's identifying name. The `pages` variable indicates the size of the block in 512-byte increments. Finally, `address` is a pointer to a doubleword location into which the operating system will store the segment and offset of the allocated block.

Once the block is created, any other process can gain access to it using the following code:

```c
returncode=sys_accgbl(blname, &address)
```

where `blname` and `address` have the same meaning as above.

The Wendin-DOS mailbox (you'll be reading about a lot of mailboxes in this article) is a kind of pseudofile that you access through the operating system's record management system routines. (The RMS calls are the entry into Wendin-DOS's file handling routines. These are separate from the DOS Int 21H calls you're probably already familiar with.)

Physically, a mailbox exists as a region in memory; logically, it looks like a file on drive MB.

The mailbox is the Wendin-DOS message queue. Once a process creates a mailbox with

```
returncode=rms_create(NULL, "MB:MYBOX", &channel, 0);
```

and writes into it, other processes can open the mailbox and read from it in sequential fashion:

```
returncode=rms_read(NULL, &channel, buffer, length);
```

where `buffer` is a pointer to the character array for holding the input, and `length` specifies the number of bytes to read. The RMS calls that I've shown have the same format for creating and reading files. This universality lifts some weight off programmers' backs.

**A Different Drummer**

Theos 86 is an operating system all to itself. At least, I don't recognize Theos as being a clone of anything. This is both a strength and a weakness: The designers of Theos were able to extend the file system to include features not found in MS-DOS. On the other hand, you have to learn all this new stuff.

Theos is billed as a multiuser operating system, but it does sport plenty of multitasking features. From the user's standpoint, you can launch a task to run in the background with the START command. So, entering `START SPOOLER` would return a prompt immediately, but it would cause `SPOOLER` to begin executing concurrently with whatever you're doing from the console.

Theos provides BASIC and C languages for program development. In BASIC, your program can create a subtask using the `ACTIVATE` command. Thereafter, tasks can communicate with one another through semaphores or common variables. Common variables look like ordinary variables but are kept in memory external to all tasks. Each task can access the common variable pool using the GET COMMON and PUT COMMON statements.

Theo's C language lets you create new tasks with the `fork()` function (which Unix programmers will recognize). You can also launch a program file from the disk as a subtask with the `spawn()` function. Once all these tasks are running, they can talk to one another through shared memory.

Shared memory works just like Wendin-DOS's global memory blocks: It's a region of memory to which a unique name is attached. Tasks running in the system can gain access to this memory by using the `shared()` function. And C supports semaphores as well, with the

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addition of remote semaphores, which allow subtasks spawned from one parent to access semaphores owned by tasks spawned by another parent. (Note that remote tasks would include tasks controlled by another user on the system.)

QNX
QNX looks a lot like Unix. Many system commands look so much like commands you’ve seen in Unix that it’s easy to be fooled. Like Theo's, QNX uses its own file system, so if you want to run both it and DOS, you’ll have to buy a second hard disk drive, partition your disk, or banish your DOS files to floppy disks.

To alleviate the loss of DOS, QNX provides two remedies. RUNDOS lets you run a DOS application as a QNX task. RUNDOS captures incoming DOS and BIOS requests and refracts them into QNX calls. This works reasonably well, and the QNX people boast support of Lotus 1-2-3, WordPerfect, Windows/286, and others.

The other remedy is DFS, which attacks the problem from a different angle. This package deludes a QNX program into thinking that an MS-DOS disk is really a QNX disk. So, for example, I could write a C program under QNX that uses the standard I/O calls—fseek(), fread(), and so on—and when I run that program with DFS, I can direct it to do its work on my MS-DOS floppy disk.

For the programmer willing to divorce himself from DOS in the interest of multitasking, QNX teams with capabilities. Intertask communication in QNX is built on messages: memory buffers of arbitrary size that can be transmitted between tasks. Once you know a task’s process ID, you send it a message via the send() command, and it uses the receive() function. Of course, this raises the question of how the sender determines the receiver’s task ID.

QNX’s answer to this is unique: A task can attach a name to itself. Most other operating systems allow names to be assigned to the abstract communications objects (i.e., the message queues, the shared memory blocks, and so on), but under QNX you can actually name a task. Thereafter, any other task can post a query to the operating system to locate the named task and determine its associated process ID.

If you prefer the named message queue approach, however, QNX provides a queue utility that you launch as a background task. This task is built on the send() and receive() commands, but it allows tasks to reference queues, rather than tasks, by name. Also, queues are buffered and nonblocking; messages aren’t. If you send a message to another task, your task waits until the other task receives the message. Best of all, queues can stretch across networked QNX machines so that tasks on your machine can communicate with tasks on remote machines as easily as if the remote tasks were executing locally.

When Money Is an Object
At least two multitasking operating systems are available that are less like commercial products and more like labors of love.

Minix, created by Andrew Tanenbaum, is a complete Unix-like operating system for the IBM XT and AT machines. Minix was created as an educational tool (its author teaches courses in operating systems), but this is no toy operating system. With only minor exceptions, Minix uses system calls identical to those of Unix version 7. (You get a complete multitasking operating system with utilities and a C compiler for under $80. Not bad.) You create new processes using the fork() function. Process communication is supported by the send() and receive() calls; the only restriction is that (on the 8088) the maximum message size is 24 bytes.

Since Minix is so closely tied to Unix, its file system is incompatible with that of MS-DOS. Nor have I seen any Minix programs for running DOS as a subtask (although it wouldn’t surprise me if one is out there somewhere). This means you’ll either have to partition your hard disk into DOS and Minix, or simply give up DOS altogether for a single large Minix partition.

In any case, if you are at all interested in multitasking in particular and operating systems in general, you should at least check out Tanenbaum’s book (see the bibliography). It contains the complete source code to the Minix kernel, with meticulous comments by the author.

XINU (a self-referencing acronym that stands for “Xinu is not Unix”) is the opus of Douglas Comer and associates. In testimony to this operating system’s adaptability, it has made its way onto PDP-11s, Sun minicomputers, VAX machines, IBM PCs, and Macintoshes.

On the PC, Xinu is something of an operating-system hybrid. You do all your development work under PC-DOS in Microsoft C and Macro Assembler (or Turbo C and Turbo Assembler) and link the result with a Xinu library to create an .EXE program. When you execute this program, Xinu takes over the computer and becomes the new operating system. The multitasking appears when you designate a function as a process using the create() function. The call looks something like this:

```
pld = create(myproc,STACK,
PRIORITY,"prool",nargs,
arglist);
```

This creates a process out of function myproc() (which you’ve defined elsewhere in your program) and returns its process ID in pld.

The process’s stack size is given by STACK, its priority defined by PRIORITY. Following the priority argument is a symbolic name to be associated with the process, and then comes the number and list of arguments to be passed into the process when it starts. Once you’ve created the process, it is suspended, so your program must jump-start it with

```
resume(pld);
```

which causes the process given by pld to execute concurrently with the caller.

Since you run Xinu as a single large C program, processes can communicate through shared memory. In this case, the
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shared memory is nothing more than global variables defined in the program’s header. For process coordination, Xinu has semaphores.

Xinu provides two message-passing systems, one built atop the other. The first is simple process-to-process message passing; the sender must know the process ID of the receiver. The second is a more versatile scheme based on ports, where a port consists of a message queue controlled by two semaphores. The first semaphore regulates input to the queue, blocking any process that tries to write to a full queue. The second semaphore controls output, blocking processes that try to read from an empty queue. The system maintains an array of ports. Any process can access a port, given that the process knows the port number.

As with Minix, Xinu is available in association with a book (see the bibliography), and be aware that there are separate editions for the PC and the Mac) providing rigorous coverage of the source code. Even if you don’t plan to use Xinu, there’s a great deal to be gained from its associated text.

**Multitasking Languages**

F83 is a remarkably extensive public domain Forth package created by Henry Laxen and Michael Perry. F83 runs on several systems, including IBM PCs, and its authors have done a lot to integrate the package with the native operating system. However, what I’m most interested in here is F83’s built-in multitasking capabilities.

Multitasking in F83 is cooperative, unlike the preemptive approach you’ve seen in the above operating-system replacements. When you create a task in F83, a data structure that defines that task is linked into a circular list (see figure 2). This data structure consists of a header field, which holds the name of the task; an entry-point field, which holds executable code that I’ll describe in a moment; a link field, which points to the next task in the list; and the task’s local data storage area. This local data storage area holds the task’s personal variable space (called user variables), return, and parameter stacks.

The currently running task passes control to the next task in the list by executing the PAUSE word. PAUSE saves the state of the current task by pushing the return stack pointer and the instruction pointer onto the parameter stack and then storing the parameter stack pointer into the local user area. Finally, PAUSE fetches the address in the LINK field and jumps to that address. If the next task is asleep, then this jump sends execution off to the Int 80H routine that F83 has patched to hold its context-switching routine. This routine resets the awakened task’s stack pointer and then unloads the instruction pointer and return stack pointer so that the task resumes where it left off. However, if the next task is asleep, this jump simply executes another jump instruction that moves along the list to the following task.

Creating a task’s data structure is done by specifying the size of the task’s local user area and stack and then giving the task a name. You create task FRANK with

400 TASK: FRANK

which allocates 400 bytes to the user area and stacks. Now, say you want FRANK to watch a variable and then ring the bell and terminate when that variable becomes 0.

VARIABLE WATCHME
1 WATCHME 1 : FRANK-DOES
FRANK ACTIVATE
BEGIN PAUSE WATCHME
@ 0= UNTIL
BEEP STOP

Executing FRANK-DOES will assign to FRANK the code following the ACTIVATE word, which simply babysits the variable WATCHME. When WATCHME goes to 0, FRANK rings the bell and, using the STOP word, puts himself to sleep forever.

Of course, it’s up to the programmer to sow PAUSE instructions in strategic places to keep one task from hogging the system (referred to as “starving” a task). Since there’s the potential for indefinite delay in many I/O operations (e.g., as the computer waits for a human to enter something at the keyboard), the low-level I/O words of F83 have PAUSE instructions built in.

Regarding interprocess communications, there is nothing specific in F83. As with almost everything else in Forth, you’ve got to build it yourself. Since the only real scoping that controls variables is the order in which they are defined, all variables are more or less global and therefore provide all the intertask communications you need.

**Mach 2**

Mach 2, a Forth system for the Mac, takes a practically identical approach to multitasking. You create tasks by building a data structure that holds the task’s user area and stacks. (Mach 2 has two more stacks than F83 has: a subroutine stack—used because Mach 2 is subroutine-threaded—and a floating-point stack used by floating-point words.) Task switching is accomplished using the PAUSE word. Also, as in F83, a task is either awakened or put to sleep by storing an instruction in the task’s entry point—referred to in Mach 2 as the STATUS variable.

Tasks in Mach 2 come in two flavors: terminal and background. A terminal task has an associated window and is therefore able to communicate with the user. A background task, as you might guess, runs in the background and is not associated with a window. To create a..."
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terminal task, you use the word TERMINAL; to create a background task, you use the word BACKGROUND. Both TERMINAL and BACKGROUND expect two values on top of the stack: the number of bytes to be allocated to the new task’s parameter stack and the number to be allocated to the subroutine stack. Therefore, to create terminal task FRANK, you use the following:

```
800 800 TERMINAL FRANK
```

Now, since FRANK needs a window, you have to define the window’s details and connect it with the task FRANK. You can see how this is done in listing 1, where I’ve defined a bare-bones window. The ADD word actually makes the window visible, and BUILD connects the window with the task FRANK. Finally, to associate actual code with FRANK, use the ACTIVATE word.

As in F83, all the I/O words in Mach 2 contain embedded PAUSE instructions. That’s why the routine in listing 1 needs no explicit PAUSE; ?TERMINAL causes task switching.

Coroutines and Modula-2

Modula-2 possesses a kind of multitasking mechanism called coroutines. The idea of a coroutine is similar to that of a subroutine, but, as the names suggest, a subroutine is subordinate to its caller while a coroutine operates at the same level as its caller. You can think of a coroutine mechanism as an explicit task switch. And if I may add a qualifier, it’s a very explicit task switch. Recall the PAUSE word in the F83 example. It performs a task switch, but, as you’ve seen, an internal scheduler determines which task is next awakened. Modula-2’s coroutine mechanism allows the task currently executing to request a switch to a specific location. Before a program can begin executing coroutines, it must assign a workspace to each coroutine. This workspace is a memory block wherein the coroutine’s local variables and stack are stored. You assign the workspace using the NEWPROCESS() procedure as follows:

```
NEWPROCESS(myproc,
ADR(workspace),
SIZE(workspace),
coroutineLoc);
```

The NEWPROCESS() procedure doesn’t cause the associated coroutine to begin executing; you have to transfer control to the routine using the TRANSFER() procedure. This looks like

```
TRANSFER(mylocation, hislocation);
```

where mylocation and hislocation are the coroutine reference variables (coroutineLoc in the NEWPROCESS() procedure above); the first is for the current routine, and the second is for the routine that processing will transfer to. You can see how this works by examining figure 3, where the main routine (MainProcess) launches two coroutines, Routine1 and Routine2.

In figure 3, it’s easy to see how the term coroutine got its name. All routines operate on an equal footing. There is no prioritization (you would have to add that explicitly). When TRANSFER() executes, the caller saves its current state (so it can be restarted where it left off) and gives control to the destination routine. Note that coroutines are procedures that do not have arguments or return values. If you examine the format of the continued on page 334

Listing 1: A Mach 2 Forth routine that builds a window and associates it with an existing task.

```
NEW WINDOW FRANKWIND
(* Give FRANKWIND a title *)
"Frank's Window" FRANKWIND TITLE
(* Identify its location and size *)
100 300 300 FRANKWIND BOUNDS
(* Add the doo-dads *)
DOCUMENT VISIBLE CLOSBOX FRANKWIND ITEMS
(* Now make the window visible *)
FRANKWIND ADD
(* Associate the window with the task *)
FRANKWIND FRANK BUILD
(* Give FRANK some code to execute *)
: FRANK - DOES ACTIVATE
BEGIN "Frank here" CR ?TERMINAL UNTIL QUIT ;
(* Turn FRANK on *)
FRANK FRANK - DOES
```

Figure 3: MainProcess executes two NEWPROCESS() calls to assign workspace to coroutines Routine1 and Routine2. One routine passes control to another via the TRANSFER() procedure.
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<tr>
<th>Part No.</th>
<th>Function</th>
<th>Price</th>
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<td>JMM1022</td>
<td>SIMM 3900-10 100ns 256 x 8</td>
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### 7400 SERIES

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<td>7402</td>
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<td>3 State NAND gate</td>
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<td>3 State NOR gate</td>
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<td>7407</td>
<td>3 State XOR gate</td>
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### 74LS SERIES

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### 74HC SERIES

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### 74HC HI-SPEED CMOS

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### TALIUM CAPACITORS

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### TRANSISTORS AND DIODES

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### MICROPROCESSOR COMPONENTS

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### EPROMS

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### EEPROMS

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### MISC. COMPONENTS

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EPROMS

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STATIC RAMS

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- Tutorials (on June 26-27) addressing major object-oriented languages (such as Smalltalk, Eiffel, Objective-C, C++, CLOS), Object-Oriented Databases, Object-Oriented Design methods and other key topics.
- Invited presentations by international object-oriented experts.
- Submitted papers on important practical aspects of object-oriented techniques.
- Demonstrations of object-oriented tools, languages, environments, databases and their applications.

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- New developments in the technology.
- Development and use of reusable component libraries.
- Management and educational issues.

Beyond this list, any paper dealing with object-oriented topics is potentially acceptable if it is of interest to industry practitioners.

Submissions may be made in the form of either full papers (8 to 15 single-spaced pages) or extended abstracts (5 or more pages including basic bibliography).

Submissions will be evaluated by the International Program Committee, chaired by Professor Jean Bézivin of the University of Nantes. Six copies of each submission should be sent to:
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All submissions must be received by March 1 to be considered for inclusion in the conference. Submissions should be in English. Notification of acceptance will be mailed by April 1st; final manuscripts will be due May 1st.

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It is anticipated that other meetings related to the topic of the conference, such as User Group meetings or standardization committees, will be organized in the same venue during the week of TOOLS '90, especially on Monday, June 25. The organizers of TOOLS '90 will help coordinate and publicize such events if they fall within the scope of the conference. Prospective meeting organizers should contact the TOOLS organizer.

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HANDS ON
SOME ASSEMBLY REQUIRED

continued from page 288

TRANSFER() procedure, you will see why. Since TRANSFER() has no way of knowing whether it is transferring to the start or the middle of the coroutine, it can’t tell whether to load the routine’s input arguments. So any communication between the main routine and coroutines (or between coroutines and each other) must take place in global variables (as in the examples I gave for F83 and Mach 2).

The Task Is Done

There’s quite a variety out there; enough to satisfy everyone’s needs. Of course, if you want full-blown development systems, you’ll probably have to pay a bit more. But it’s good to know that if you decide to replace money spent with some old-fashioned time and sweat to get your multitasking, you can do that, too.

Certainly, there are problems. Any multitasking operating system running on the 8088/8086 is going to be flying without any task protection. There’s no keeping an insane process from loading up its segment registers with whatever it pleases and laying waste to the operating system’s kernel. (Interesting aside: The Wendin people are up-front about this to the degree that their manual provides a road map of the Wendin-DOS kernel’s data structures. I guess they figure that if you’re going to get yourself into trouble, you might as well be informed about it.)

Still, I’ve gotten plenty of good work done thanks to DESQview, and I intend to continue my development work with multitasking systems. These will certainly include more than one of the selections I’ve presented this month. The bottom line, I suppose, is that a Mac Plus with a 20-megabyte hard disk drive or an XT with a hard disk drive and 640K bytes isn’t such a has-been after all.

BIBLIOGRAPHY


Rick Grehan is the director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in computer science/mathematics from Memphis State University. He can be reached on BIX as “rick_g.”

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Matter at the End of Its Tether

In technology, small is beautiful, not to mention cooler and cheaper

Publishing is a ballet of delays. When I wrote about Fred Warshofsky's The Chip War (June 1989), George Gilder's Microcosm: The Quantum Revolution in Economics and Technology (Simon & Schuster, New York) was still undergoing the peristaltic rhythms of what is grandly called "production."

About the time my Warshofsky review appeared, a "proof copy" of Gilder's book turned up in the mail. (Reviewers, you should understand, seldom see actual books. They are sent error-ridden paperbound page proofs, which lack such essentials as the index whereby they might find something a second time. The page numbers, even, are written in by hand and not to be relied on.) The Gilder proof copy seemed especially error-prone, and I put it to one side. And now that I have a hardbound copy fit to appraise, I must write this four months before you'll see it, which will be eight months after you saw my Warshofsky piece, if you did.

All of which helps explain why one optimal scenario, a Warshofsky-Gilder confrontation, couldn't be arranged. So I'll summarize it en route to trying another scenario. The Chip War, briefly, deplored a series of fumbles whereby production of components like video RAMs became a Far Eastern monopoly. But Microcosm says, pooh, that needn't matter, if we can stop fussing about our Asian brethren and stop lobbying Washington and just resume confidence in our normal strength, which is design.

For what Japan mass-produces is merely replacement parts, which design routinely obsolesces.

And that claim is a detail of a larger historical vision. What Gilder sees as the prime theme of at least the past century is the steady obsolescence of matter as a key to importance, to wealth. That rhymes with a lifelong theme of Buckminster Fuller's, who preached a long-term trend "from tracked to trackless, from wired to wireless, from visible to invisible." It pleased Fuller that the year he was born—1895—was the very year W. C. Roentgen sent his famous rays clear through what had always seemed "solid"; the same year, too, that Marconi did without wires, Charles Duryea without tracks. (Duryea? He patented the first American gasoline-engine car.)

It's noteworthy how fast and how frequently Roentgen's work got replicated. Within months they were pumping out x-rays in places as remote from Wuerzburg as Colorado, shouting "Lo!" as the rays streamed through boxes and hands to limn shadowy coins and bones. That matter might be transparent, perhaps as a first step toward being nonexistent, must have seemed a theme to rejoice in. For how matter did load nineteenth-century shoulders!

"Wealth"—that was once land and treasure, slaves and armies; later, wealth was ore and oil and regimented labor. But today, "The global network of telecommunications carries more valuable goods than all the world's supertankers," says Gilder. What it carries is literally weightless.

Still, for most people, Newton's world remains definitive. Solids bang against solids; reaction accompanies action. In the Freudian psyche, pressures build up like steam. In even the theologians' world, effect follows cause. So (says MIT mathematician Gian Carlo Rota), "Our logic is patterned exclusively on the structure of physical objects."

Thus, most people are out of date (and even think wealth is gold). For according to their logic, quantum theory makes no sense. Meanwhile, millions of appliances—TVs, radios, microwaves, computers—prove that transistors are doing something reliably. And since (to cut a long story short) our transistorized technology posits quantum theory, we'd best abandon such logic and plunge into the continued
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microcosm, where whatever we can think of is forever invisible—don't even try to draw a picture of a quark—and events seem to work the way the mind does, by making leaps.

The focal figure of Microcosm is Carver Mead, 56 this year, who (among other feats) showed that "as you move down into the microcosm...everything gets better as it gets smaller, cooler as it gets faster, cheaper as it gets more valuable. As the traffic of electrons becomes denser, speedier, more complex, and more plentiful, the number of accidents drops, defects decline, and nothing ever wears out."

It was the replacement-part mentality that paved the way for Japan.

That's contrary to the Newton-based intuition that the smaller the more fragile, the more complex the less reliable. Mead foresaw a whole computer on a chip, salable at a few dollars, as long ago as 1968. He's waged lifelong war against all that seemed plausible in 1945 to John von Neumann: all that till very lately has dominated computer architecture.

Not that von Neumann was wrong in his time. Switches (vacuum tubes) were expensive, wire was cheap. So economize on the tubes, using miles of wire. That meant a CPU, which we wire to "memory" cells that are wired to one another, the whole then wired to input (cards, keyboard, ROM) and to output (printer, CRT). But today, says Mead, "It is wire that has become costly in every way, clogging the chip with complex metals hard to lay down, subject to deterioration from heat, and difficult and expensive to link to the world." Meanwhile, processor and memory "all can be made of the same sliver of silicon." And silicon (sand) is the cheapest stuff in the world.

That can all seem obvious in 1990. Unhappily, it became evident to the industry far less suddenly than it did to Mead. For a long time, the transistor was a substitute for the vacuum tube: a cooler (and, by golly, cheaper!) .

And, getting there, we'll need the "silicon compilers," to which Gilder devotes a whole fascinating section: software that designs microchips, not the logic but the physical chips themselves; and not "neater" chips than human designers can manage, just cheaper ones, faster ones. For by orthodox methods, whereby women cut lines in huge sheets of Mylar with Xacto knives, "a single 1990s design would take up much of the Bay Area and have most of its female population crawling across Mylar on knee pads."

That's not the way Chips & Technologies, an outfit you may have heard of, cloned the IBM AT. Using silicon compilation and concentrating on the support chips Intel's 80286 had obliged, they got the total chip count down from IBM's 130 to 47, the power consumption down by 60 percent. Fabricating the new chips? Sure. contract that out to Japan. Why not? And sell the output to Tandy, Dell, Olivetti, Siemens, NEC, Sony, Epson, Goldstar, Daewoo...That list kept lengthening, while at IBM they struggled to comprehend what was going on.

Likewise at Weitek, two Chinese-American defectors from Hewlett-Packard achieved generic microprocessors disentangled from Intel and Motorola CPUs. The market turned out to be twice as large as that for the "gofta" devices: the ones that will work only with a specified microprocessor.

Not greatly publicized, silicon compilers are here. So are silicon analog units. Combine them. and, lo. design! And, lo, the end of the replacement-part philosophy. And (given no loss of nerve) the end of the Asian Peril. And special-purpose devices proliferating. And Gilder's utopia. our triumph over matter. For we didn't launch off from solidity. "In the beginning was...the idea."

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper's. His recent books include A Sinking Island and Mazes. He can be contacted by BIX as "hkenner."

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Consider the AT bus. It has a 16-bit-wide data path and a maximum bandwidth (data transfer rate) of about 6 megabytes per second. Now, suppose you want to perform some animation on your new 80486 "screamer" with its AT bus. Good-looking animation requires the display of about 30 frames per second. If you have a high-resolution monitor (e.g., 1 million pixels), that means you need to manipulate 30 megabytes per second. The AT bus is obviously not up to the task. Plus, if you want realistic color, you'll need a 32-bit-wide data bus to store all those pixel definitions. That means that you've got a blazing CPU without the bus architecture necessary to support it.

Nor is IBM's Micro Channel Architecture—which has a maximum bandwidth of about 20 megabytes per second—up to the task of animation. The Extended Industry Standard Architecture (EISA) maximum bandwidth is 33 megabytes per second. If you add the overhead for bus arbitration, interrupts, background tasks, and so forth, even the EISA bus would not cut the mustard in a high-resolution animation application.

The demand for high-performance graphics caused Hewlett-Packard to add a custom bus to its new EISA-bus Vectra 486. The special bus is dedicated to a "Super VGA" graphics controller and can handle as much as 40 megabytes per second. High-performance graphics is one of the reasons that Sun came up with its SBus, which can handle up to 80 megabytes per second.

The AT bus has equally serious limitations when used in network server systems. It simply doesn't have the data bandwidth necessary to ensure fast performance on a network. Here, the MCA and EISA buses perform much better. And new systems, like the NetFrame, that support additional I/O channels and coprocessors are specifically designed to accommodate large networks and at the same time preserve compatibility with the IBM PC architecture.

The AT bus is also inadequate for multitasking operating systems like Unix and OS/2, particularly in 32-bit mode. When the 32-bit 80386 version of OS/2 comes out this year, machines with the AT bus will have a hard time keeping up. Unix users are already experiencing the frustrations of running Unix on an 80386 system with the AT bus. When you start performing multiple tasks, all of which are trying to access the bus, performance slows down to a crawl.

The gist of this argument is that the AT bus was not designed for 32-bit graphics, network I/O, or multitasking operating systems. It was designed for single-user, single-tasking PCs before the era of PC-based CAD and network applications. The 80386, 80486, and RISC processors like the SPARC or R3000 chips, on the other hand, are designed to take on the applications typically performed by minicomputers and mainframes. Just as it makes no sense to buy an 80386 if all you need to do is some word processing or a couple of mailing lists, it also makes no sense to build a machine with such a high-performance processor connected to the slow and limited AT bus.

Nevertheless, many clone vendors are doing exactly that. They're serving up cheap machines based on old technology, the only difference being that they have the latest CPU. These machines are deceptively fast when used in single-user mode and with simple graphics applications or standard PC business applications. And don't get me wrong—there's still a lot of life in the AT bus for those applications.

But you just might be in for a big disappointment.

Nick Baran is the West Coast Bureau Chief for BYTE. He can be reached on BIX as "nickbaran."
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